BRAIN.

PART IV, VOL. 42.

SUGGESTION AND SUGGESTIBILITY.[1]

BY E. PRIDEAUX.

§ 1.—DEFINITIONS OF SUGGESTION.
§ 2.—VARIETIES OF SUGGESTIBILITY.
§ 3.—CLASSIFICATION OF THE RESPONSES TO SUGGESTION.
§ 4.—ABNORMAL SUGGESTION.
§ 5.—SUGGESTION AS A METHOD OF TREATMENT.

§ 1.—DEFINITIONS OF SUGGESTION.

THE controversies between psychologists and neurologists as to the nature and treatment of the psycho-neuroses are largely due to the employment by both parties of the same words in different senses, and, as a striking instance of this, the word "suggestion" has been responsible for considerable confusion. For many neurologists suggestion is the beginning and the end of all diseases of psychogenetic origin, both as an ætiological factor and as a method of treatment. Even amongst psychologists there seems to be no real agreement as to the meaning of the word, and it is often used as if it were an explanation for a mechanism which is not understood.

The various definitions which have been given of the term "suggestion" make it obvious that different degrees of the same process are being referred to. These definitions can be divided roughly into two classes according as they refer to: (*a*) *Normal suggestion*, which takes place in everyday life in all of us; or (*b*) *Abnormal suggestion*, which takes place in psychoneurotic patients, and in normal persons under abnormal conditions. It is difficult to draw any hard-and-fast line between the two, for the difference is one of degree only, and appears to depend on the individual tendencies of the subject, whereas the mechanism remains the same in both classes. The term "suggestion," as used by Janet, Dejerine, Grasset, and Babinski, refers to abnormal suggestion only. Janet defines it as "the complete and automatic

[1] Read before the British Psychological Society (Medical Section), October 29, 1919.

development of an idea which takes place outside the will and personal perception of the subject" [6], and Dejerine and Grasset hold a similar view. For Babinski the process is one of suggestion only when the idea conveyed is unreasonable [1]. The broadest definition is that of Bernheim, who defines it as "the process by which an idea is awakened in the mind of a subject, and accepted" [2]. This definition includes all varieties of suggestion, but does not clearly mark it off from other mental processes. The definition which is now often accepted by the English School of Psychologists is that of McDougall, given in his "Social Psychology," viz., "Suggestion is a process of communication resulting in the acceptance with conviction of the communicated proposition in the absence of logically adequate grounds for its acceptance" [12]. This definition includes both normal and abnormal suggestion, but does not make it clear whether the action is limited to processes in which there is a relationship between two persons only—a limitation which seems to be unnecessary, as it excludes auto-suggestion. McDougall could improve his definition and make it include every variety by making it read: "Suggestion is a mental process resulting in the acceptance with conviction of a proposition in the absence of logically adequate grounds for its acceptance"; and this is the definition which I put forward for the purpose of this discussion. McDougall classifies suggestion amongst his general innate tendencies as a pseudo-instinct [13], and I think it would be profitable to discuss whether it is necessary to maintain this view or whether the process of suggestion cannot be explained in some other way.

We have then to explain why it is that we accept with conviction and act upon propositions made or occurring to us without any adequately logical grounds for so doing.

If there are logical grounds for accepting the proposition, the idea is generally called *persuasion*, but it is difficult to separate this from suggestion, and it seems better to include it—at any rate when used in psychotherapy as a form of normal suggestion, for there are often no logical grounds for accepting the proposition, but only logical grounds on the part of the physician for persuading the patient to accept it; moreover, to obtain conviction, affective processes must come into play, for the way of saying a thing is more important than what is said, which is expressed in the statement: "Manner is more important than matter."

There can be no doubt that *suggestibility* is the chief factor in the

process of suggestion, and that the process is a subjective one; we have learnt as the result of psycho-analytical investigation that this state is not a passive state of receptivity, and that the mind cannot be compared to a vacant seat waiting for someone to fill it, as was originally held, but that it is the result of active mental processes going on in the mind of the subject, and particularly of affective processes.

Ernest Jones has called attention to the distinction between verbal suggestion on the one hand, and affective suggestion on the other [7], and maintains that the latter is the more fundamental, and is the necessary basis for the former, which view accords with Bleuler's statement, quoted by Jones, "Suggestion is an affective process." [8]. This view seems to be by no means generally accepted, but a consideration of the facts with which we are familiar concerning suggestibility compels us to admit its truth, and an examination of those facts shows more clearly the general nature of the whole process of suggestion.

§ 2.—Varieties of Suggestibility.

The chief facts are that: (*a*) suggestibility varies in different persons irrespective of the nature of the suggestion, and of the suggestor; (*b*) suggestibility varies in the same person at different times and under different conditions; (*c*) suggestibility may have reference to a particular system of ideas only; (*d*) a person may be suggestible towards one person and not towards another. I call these four distinct states of suggestibility: (*a*) individual; (*b*) conditional; (*c*) specific; (*d*) personal.

(*a*) *Individual suggestibility.*—The fact that suggestibility varies in different persons irrespective of the nature of the suggestion makes it important in psycho-therapy to be able to recognize what other characteristics are associated with exaggerated suggestibility. It is exaggerated in the child and diminished in old age: it is exaggerated in those whose egoistic instinctive tendencies are excessively developed and who make little attempt at self-control and so act on impulse, the class of persons originally described as having a sanguine temperament. This class corresponds to the "extrovert" of Jung, the "motor" type of Baldwin, the "objective" type of Bain, and the "tough-minded" of James. Suggestibility is also exaggerated in crowds, whose other characteristics are impulsiveness and incapacity to reason, with absence of judgment and of the critical spirit. Le Bon points out that "the decisions affecting matters of general interest come to by an assembly

of men of distinction, but specialists in different walks of life, are not sensibly superior to the decisions that would be adopted by a gathering of imbeciles" [11].

I think also that suggestibility is more marked in those who live in the south and warm climates than in those who live in the north and cold climates, and that those whose associations of ideas take place by contiguity are more suggestible than those who associate by similarity.

It is less marked in those who hold strong principles and ideals, in methodical thinkers, whose critical powers have been well developed, and in those with the so-called "bilious" temperament, who correspond to the "introvert," the "sensory" type, the "subjective" type, and the "tender-minded."

Suggestibility is very much exaggerated in the patient with "conversion hysteria," and this has led Babinski to enunciate his conception that hysteria is due to suggestion. This conception has been accepted by many neurologists in this country, who have little knowledge of the mental processes at work in the process of suggestion and use the term in a very limited sense. When we recognize suggestion as an affective process, then we can agree with Babinski that hysterical symptoms are produced by suggestion, but we shall not be able to accept his view that hysteria be limited to the symptoms of "conversion hysteria." I therefore think it is unfortunate that Rivers should have proposed the use of the term "suggestion neurosis" as a substitute for "conversion hysteria" in his paper, "War Neurosis and Military Training" [16]. Moreover, so long as the present confusion exists in the meaning of the term suggestion the less we use it the better.

Investigations which I have been carrying out during the past year on the "psycho-galvanic reflex" point to the fact that exaggerated suggestibility is always associated with a low "emotive response," and Dr. Snowden informs me that similar results have been obtained by Dr. Golla and himself at the Maudsley Hospital. If it could be shown that the converse is true, that a low emotive response is always associated with exaggerated suggestibility, then we should have a means of measuring suggestibility. More work needs to be done on this subject, for apart from the fact that we are not yet decided as to the physiological nature of the reflex, it seems certain from the psychological standpoint that two factors must be taken into account, the liberation of emotion on the one hand, and the stimulation of "contrary" forces on the other. I use the term "contrary" forces in order to avoid the

words "repressing," "inhibiting," and "controlling." I mean the forces which are brought into action by stimulation of mental processes on a higher level: they are "contrary" as applied to suggestion, and act in opposition to the instinctive processes on the perceptual level. Physiologically they are the forces set free by stimulation of the cerebral cortex; following Rivers in the symposium on "Instinct and the Unconscious," I might perhaps use Head's term and call them "epicritic." It is possible that the psychogalvanic reflex may be an indication of the strength of the "contrary" or "epicritic" forces stimulated by the liberated emotion, and that it is not merely an emotive response.

From a consideration of these facts we can explain individual suggestibility as being due to the varying degree in which the egoistic instinctive tendencies are developed and the manner in which the sentiments have become organized to form ideals and act as contrary forces.

(*b*) *Conditional suggestibility.*—The variation of suggestibility in the same person at different times and under different conditions seems to depend upon the affective state in which the person happens to be, and the relation of the suggested idea to that state. I have found that even patients who generally go into a deep state of hypnosis are resistant to hypnosis on one day and will go off into their usual state on the next. Suggestibility is increased during hypnosis, fatigue, illness, and prolonged emotional states, and by the effect of alcohol and certain drugs, conditions in which the "contrary" forces are weakened. A wife, for example, recognizes that a husband is more suggestible after a good dinner and chooses this time to get her propositions accepted.

(*c*) *Specific suggestibility.*—That suggestibility may refer to a particular system of ideas only is also an important fact pointing to the affective nature of the process. A person is specially suggestible to ideas that are pleasing to him and which satisfy his egoistic instinctive tendencies; according as those specific tendencies are developed so does his suggestibility vary towards ideas which evoke them, and we recognize that in the same family these tendencies are developed in each of the children in varying degree.

With the growth of sentiments and the appearance of complexes and interests, both actual and dispositional, as the result of experience, so does the suggestibility vary according as the suggestions harmonize with the affective states induced by them. Thus each person has his own particular sphere of suggestibility, and even under hypnosis the

suggestibility is not the same for all suggestions. This is more clearly explained by a quotation from a paper by Ernest Jones on "Psychoanalysis and Education": "A desire that arises in a person's mind for the first time is not likely to be very effective or significant unless it becomes attached to others that are already present; in other words, a motive appeals more readily to him if it is linked, by resemblance, to earlier ones already operative in him." [9].

(*d*) *Personal suggestibility.*—Suggestibility towards one person and not towards another depends on the affective processes operating between the two persons. Sympathy, respect and confidence between the subject and the suggestor favour suggestibility. I have found it more difficult to hypnotize the patient of a colleague than one of my own.

Anything which tends to increase the authority and prestige, either personal or acquired, of the suggestor, increases suggestibility in the subject; thus a parent can produce suggestibility in a child, a teacher in a pupil, and a physician in a patient.

McDougall has pointed out that the personality comes into play in virtue of the relative strengths of the two instincts of "self-assertion" and "subjection." "Personal contact with any of our fellows seems regularly to bring one or other, or both, of these instincts into play" [14], so that suggestibility is only evoked in us by persons who make upon us an impression of superiority of any kind in the particular situation of the moment. McDougall relies on the strength of these two instincts to explain individual suggestibility: but although they are important—especially the instinct of self-assertion in virtue of the part it plays in the organization of the sentiments on a higher level—other instincts play an equally important part. It is probable that prestige owes its power to the complex emotions of admiration and awe, and often of gratitude and reverence, which are evoked by the instincts of curiosity, subjection, self-preservation, and the parental instinct. Whether we accept Freud's view, that the above tendencies are but sublimations of the sexual instinct, or not, we have got to admit the influence of the sexual instinct, for we know that a sentiment of love or affection favours the sympathetic induction of emotion between two persons. According to Ferenczi: "Everything points to the conclusion that an unconscious sexual element is at the basis of every sympathetic emotion, and that when two people meet, whether of the same or the opposite sex, the unconscious always makes an effort towards transference" [3] and that this transference has its deepest roots in the

repressed parental complexes. It is also significant that in the two classes of homo-sexuals, described by Ferenczi [4], the "subject" and "object homo-erotics," the "subject-homo-erotic" has an increased suggestibility, and although my experience of these cases is small, it is that the "object-homo-erotic" is not at all amenable to suggestion.

It is outside the scope of this discussion to go further into the psycho-analytical standpoint, and Ernest Jones has already set forth the Freudian point of view in his paper on the "Action of Suggestion in Psychotherapy" [10] to the effect that "suggestion" is a special variety of transference, namely, that concerned with the transference of positive affects to the physician, and that suggestibility takes its root in the masochistic component of the sexual instinct. It is impossible for anyone to discover the truth of Freud's theories without psycho-analytical investigation; my own position is that I accept the greater part of Freud's theories in so far as the fate of the "pleasure-principle" is concerned, and his theory of sexual development and sublimation has been confirmed by my experience in psycho-analysis, but I think that the development and sensitivity of the "reality principle" is of much more importance than Freud seems to allow, and that Janet is right in so far as he emphasizes its significance.

A consideration then of facts shows that all four forms of suggestibility, which I have described as individual, conditional, specific, and personal, come into play in the process of suggestion, and that these are affective states evoked by the stimulation of different instinctive tendencies, sentiments, interests, and complexes.

§ 3.—Classification of the Responses to Suggestion.

Any explanation of suggestion must explain not only why suggestions are accepted, but also the circumstances under which they are refused, and even strongly opposed. If we take the results of attempts at suggestion in everyday life we can classify them into three groups:—

(*a*) Positive response when the suggestion is accepted.

(*b*) Negative response when the suggestion is opposed.

(*c*) Neutral response when the suggestion is refused.

These results depend on the relationship of the suggested idea to the different states of suggestibility already described.

(*a*) *Positive response* may be immediate or delayed; the immediate response gives us the most typical example of the process of suggestion, for in the delayed response there are also at work other factors which I shall describe under "neutral response."

Most writers are inclined to the view that if a suggestion is accepted it is due to the inhibition of other ideas opposing its acceptance, and that realization of the idea takes place simply by ideo-motor action. This view involves the difficulty that it depends on the meaning of inhibition, and that we do not understand the nature of ideo-motor action.

Hart in his paper, "Methods of Psychotherapy" [5], attaches great importance to inhibition, but recognizes that it is brought about by affective processes; for him "suggestion" is "complex thinking," by which he means thinking due to the action of a complex, using the term complex in a very wide sense. He speaks of the capacity of suggestion "for inhibiting conflicting ideas and tendencies." This seems to be an inadmissible use of the word "inhibition"; the verb "to inhibit" is an active and transitive verb, and the word "inhibition" thus conveys the idea of an active process. If I go downstairs, it might be true to say that by so doing I was inhibited from going upstairs, but it would hardly be a correct usage of the word; the idea of going up would never arise and would not require inhibition. Suggestion has no capacity for inhibiting ideas, but, if we speak in terms of inhibition, is rather the consequence of the inhibition of inhibiting forces normally involved in volition.

Moreover, the term "complex thinking" lays too much stress on the cognitive aspect of the process of suggestion, and though this is the first stage in the process, more than this seems to be involved; for example, if, during a railway strike, I merely thought of an engine as the means of transport for getting me to town, nothing further would result, but if forces were aroused in me sufficiently strong to make me "tip" the engine-driver, then I should be acting under the influence of suggestion. No other ideas would arise if the response was immediate, and no ideas would be inhibited.

The term "ideo-motor action" is a relic of the old psychology of ideas; for example, for Hegel, "an idea is a force, and is only inactive in so far as it is held in check by other ideas" [21]. If the process of ideo-motor action be analysed, it is found that the action depends entirely on the affective forces aroused by the idea, and that no idea will realize itself unless it is reinforced by some affective force. Ideo-motor action is thus equivalent to the expression of emotion. We know that emotion is expressed normally through the autonomic nervous system, and, when excessive, through the central nervous system. It is evident that persons, whose instinctive tendencies

are highly developed, and whose sentiments have not been well organized to act as "contrary forces," will realize their ideas in action through the central nervous system without opposition, and I have shown elsewhere that this may be an explanation why a patient with conversion hysteria develops symptoms attributable to the central nervous system, and a patient with anxiety hysteria develops symptoms attributable to the autonomic nervous system.

It follows from what I have already said that I here maintain the view that an idea is accepted because it harmonizes with some pre-formed interest, sentiment, or complex, that the affective forces involved give it the necessary reinforcing power to realize itself in opposition to all "contrary forces," and that it is these affective forces which produce conviction. Any condition which tends to weaken the "contrary forces" on the one hand, or strengthen the compatible affective forces on the other, favours the process of suggestion, and we have noted that the conditions which cause "conditional suggestibility" are those which weaken the volitional forces, and that individual suggestibility is exaggerated in those who are endowed with strong emotional tendencies and have a poor development of self-control.

McDougall has shown that it is the organization and strength of the self-regarding sentiment in relation to the other sentiments which determines our line of action and constitutes our self-control; as this higher control, though it relies for its strength on the self-regarding sentiment, involves the formation of ideals, and is, perhaps, influenced by the herd instinct, I have called it elsewhere the "social ideal self" as a contrast to the "individual self" [15]. Individual suggestibility then depends very largely on the strength of the social ideal self; and the weaker the social ideal self, the greater the number of complexes that remain unsublimated, and the greater are the states of specific and personal suggestibility.

Wilfred Trotter has pointed out how one form of suggestion, "herd suggestion," is due to the action of herd instinct, and that "anything which dissociates a suggestion from the herd will tend to ensure such a suggestion being rejected" [20]. It is owing to the influence of the herd instinct that we may accept propositions in regard to religion, politics, and education. Such beliefs are non-rational, and are accepted by us as the result of accumulated suggestions.

The exaggerated suggestibility of children, occurring when they have reached the age of paying attention, which is in its turn dependent on the interest aroused, is due to the evocation of the instinct of

submission, the weakness of the social ideal self, and the absence of resistance complexes. For opposite reasons old people are less suggestible.

(*a*) *Negative response* is the response obtained when not only is the suggested idea incompatible with pre-formed sentiments and interests, but it arouses contrary emotions and sentiments. This is the process which is called "contra-suggestion." The mechanism is the same as for the positive response, but an opposing set of forces are set in action with the production of a state of "negativism"—a state which is the direct counterpart to suggestibility. This state, like suggestibility, may have individual, conditional, specific, or personal tendencies. It seems to be a form of over-determination due to the presence of antagonistic complexes, which more than counterbalance the forces of a weak social ideal self.

Like suggestibility, negativism may be exaggerated, and become pathological; it is most marked in dementia præcox.

Some people appear to adopt "negativism" as a habit; such are the people we call "cranks." I look upon the action of these people as being that of over-determination, owing to the formation of complexes associated with painful experiences in the past.

In psychotherapy, when we have established an atmosphere of cure, negativism signifies an unconscious resistance to recovery, and when exaggerated it must make us suspect dementia præcox, or malingering if it seems likely that the resistance is a conscious one.

(*c*) *Neutral response.*—It is hard to draw the line between the lower forms of volition and suggestion. If the idea is incompatible with the social ideal self and the social ideal self is strong, then the process is one of volition and we get a neutral response; this is what happens in those who hold strong principles and ideals. If the social ideal is too weak, and the affective forces aroused are strong, the idea is accepted and the process is one of suggestion.

If the idea has not made sufficient impression, we get a neutral response, and this is due to the fact that there are no pre-formed interests or complexes to which it can attach itself: in this case the suggestion is ignored. This is seen most markedly in certain imbeciles. The suggestion may need repetition to give it the necessary amount of prestige for acceptance, a fact which is taken into consideration as a basis for all advertisements. The suggestion may be incompatible with such interests and complexes as exist, and the forces involved simply neutralize each other, which is one of the reasons for the fact that the

suggestions of the younger generation are not easily accepted by the elder.

A neutral response may also be the result of a conflict of motives due to the incompatibility of the interests aroused, with the production of a state of doubt, which is seen in an exaggerated form in cases of anxiety hysteria: in such cases the suggestion may be accepted after deliberation either to relieve tension, or when a decision is brought about by the reinforcement of one side of the conflict by further affective forces: or the conflict may be forgotten and only at some later period will one side of the conflict materialize by the stimulation of affective forces which harmonize with it. A neutral response will also occur in cases of "dementia."

§ 4.—Abnormal Suggestion.

The process in abnormal suggestion is the same as in normal suggestion, and depends on the factors already discussed, which increase the various states of suggestibility. The difference is only one of degree, and in abnormal suggestion the affective forces are stronger, and the "contrary forces" are weaker, so that the person is less or not at all aware of their action and has little or no control over them. This is best seen in persons suffering from hysteria; when their affective states are dominated by the desire to escape from some irksome duty or future danger, to astonish, attract attention or sympathy, any idea harmonizing with this state becomes reinforced and realizes itself.

We also know that hysterical patients can temporarily put aside their hysteria by a change in their affective state when the situation requires particular concentration on some interesting function or amusement. I think that the disappearance of hysterical symptoms as if by magic in the presence of danger and the sudden recoveries reported in the newspapers are explained by the fact that one affective state is substituted for another by the re-direction of attention under the influence of surprise. I regard hypnosis, in accordance with Bernheim's view, as an exaggerated form of suggestion. I cannot accept Rivers's statement in "War Neurosis and Military Training," that, "In the hypnotic state the individual responds immediately and without question or hesitation, not merely to the command of his hypnotizer, but even to a desire or impulse of the hypnotizer's mind which is not expressed by speech or obvious gesture" [17]. It implies the presence of some mysterious force, an idea which we are only just beginning to uproot from the popular mind, and my own experience,

submission, the weakness of the social ideal self, and the absence of resistance complexes. For opposite reasons old people are less suggestible.

(*a*) *Negative response* is the response obtained when not only is the suggested idea incompatible with pre-formed sentiments and interests, but it arouses contrary emotions and sentiments. This is the process which is called "contra-suggestion." The mechanism is the same as for the positive response, but an opposing set of forces are set in action with the production of a state of "negativism"—a state which is the direct counterpart to suggestibility. This state, like suggestibility, may have individual, conditional, specific, or personal tendencies. It seems to be a form of over-determination due to the presence of antagonistic complexes, which more than counterbalance the forces of a weak social ideal self.

Like suggestibility, negativism may be exaggerated, and become pathological; it is most marked in dementia præcox.

Some people appear to adopt "negativism" as a habit; such are the people we call "cranks." I look upon the action of these people as being that of over-determination, owing to the formation of complexes associated with painful experiences in the past.

In psychotherapy, when we have established an atmosphere of cure, negativism signifies an unconscious resistance to recovery, and when exaggerated it must make us suspect dementia præcox, or malingering if it seems likely that the resistance is a conscious one.

(*c*) *Neutral response.*—It is hard to draw the line between the lower forms of volition and suggestion. If the idea is incompatible with the social ideal self and the social ideal self is strong, then the process is one of volition and we get a neutral response; this is what happens in those who hold strong principles and ideals. If the social ideal is too weak, and the affective forces aroused are strong, the idea is accepted and the process is one of suggestion.

If the idea has not made sufficient impression, we get a neutral response, and this is due to the fact that there are no pre-formed interests or complexes to which it can attach itself: in this case the suggestion is ignored. This is seen most markedly in certain imbeciles. The suggestion may need repetition to give it the necessary amount of prestige for acceptance, a fact which is taken into consideration as a basis for all advertisements. The suggestion may be incompatible with such interests and complexes as exist, and the forces involved simply neutralize each other, which is one of the reasons for the fact that the

suggestions of the younger generation are not easily accepted by the elder.

A neutral response may also be the result of a conflict of motives due to the incompatibility of the interests aroused, with the production of a state of doubt, which is seen in an exaggerated form in cases of anxiety hysteria: in such cases the suggestion may be accepted after deliberation either to relieve tension, or when a decision is brought about by the reinforcement of one side of the conflict by further affective forces: or the conflict may be forgotten and only at some later period will one side of the conflict materialize by the stimulation of affective forces which harmonize with it. A neutral response will also occur in cases of "dementia."

§ 4.—Abnormal Suggestion.

The process in abnormal suggestion is the same as in normal suggestion, and depends on the factors already discussed, which increase the various states of suggestibility. The difference is only one of degree, and in abnormal suggestion the affective forces are stronger, and the "contrary forces" are weaker, so that the person is less or not at all aware of their action and has little or no control over them. This is best seen in persons suffering from hysteria; when their affective states are dominated by the desire to escape from some irksome duty or future danger, to astonish, attract attention or sympathy, any idea harmonizing with this state becomes reinforced and realizes itself.

We also know that hysterical patients can temporarily put aside their hysteria by a change in their affective state when the situation requires particular concentration on some interesting function or amusement. I think that the disappearance of hysterical symptoms as if by magic in the presence of danger and the sudden recoveries reported in the newspapers are explained by the fact that one affective state is substituted for another by the re-direction of attention under the influence of surprise. I regard hypnosis, in accordance with Bernheim's view, as an exaggerated form of suggestion. I cannot accept Rivers's statement in "War Neurosis and Military Training," that, "In the hypnotic state the individual responds immediately and without question or hesitation, not merely to the command of his hypnotizer, but even to a desire or impulse of the hypnotizer's mind which is not expressed by speech or obvious gesture" [17]. It implies the presence of some mysterious force, an idea which we are only just beginning to uproot from the popular mind, and my own experience,

and I think that of all other observers of recent times, is entirely opposed to it.

The explanation of suggestion I have given seems to make it incorrect to classify suggestion as an innate tendency. We have seen that there is no one single state which we can call suggestibility, but that there are several states of suggestibility, and that these are induced by the stimulation of different instinctive tendencies, sentiments, interests, and complexes.

We have seen that a suggestion is accepted because it harmonizes with these states, that the affective forces aroused give it the necessary reinforcing power to realize itself, and that it is these affective forces which produce conviction. We have now to consider briefly how we can apply this conception to suggestion as a method of treatment.

§ 5.—Suggestion as a Method of Treatment.

The object to be attained in treatment by suggestion is to produce a condition of mind in the patient which will set in action the right affective forces for the induction of those states of suggestibility which will harmonize with and reinforce the ideas to be suggested and so get them accepted with conviction.

The first step in the process is for the physician to induce a state of personal suggestibility in the patient, and this he does by arousing in him the necessary instinctive tendencies, showing him sympathy, and impressing him with a knowledge of and interest in his condition, so that the patient has respect for and confidence in the physician. In neurasthenic hospitals, where an atmosphere of cure is present, this state is induced in him on admission by the patients, who have been already relieved of their symptoms, for success is the greatest creator of prestige.

The physician then proceeds according to the type of patient he has to deal with, and to the amount of personal suggestibility already induced; if the states of individual and conditional suggestibility are exaggerated, then it will not matter what form the suggestion takes; but if there is only particular suggestibility, then it is necessary, if possible, to find out its nature by therapeutic conversations and superficial analysis, and so to arrange the suggestions as to be compatible with it.

In one form of abnormal suggestion advantage is taken of the effects of some emotional reaction to alter the affective state. An emotion

frequently used is that of surprise, which "tends to free the mind from what before occupied it, and to increase the intensity of every emotion with which it blends, or by which it is rapidly followed" [18]. If the affective state be that dominated by fear, it may be counterbalanced by inducing a state of anger, for "the emotions of fear and anger tend to exclude one another from simultaneous activity" [19]. I think also that painful electricity, the use of which has done considerable harm, and isolation, depend largely for their results on the change of affective states induced by them.

Other methods depend on the fact that the suggestion will not be accepted with conviction unless it is associated with some specific treatment to account for the cure. This form of suggestion is "indirect suggestion," and is often used quite unconsciously by the medical profession. It is used either by insinuation with the help of massage, drugs, electricity, or by deliberate deception—for example, the use of water without morphia as an injection and the use of bread pills for functional vomiting. Hypnosis is in most cases unnecessary, and although at one time I used it very extensively, I now only use it to clear up an extensive amnesia.

Of the methods of "suggestion treatment," there is no question that the method of normal suggestion by explanation and appeals to feelings is the best, as the patient then realizes that he himself is responsible for the removal of symptoms, and he will know what to do in case of a relapse. In the other methods he relies entirely on the physician, does not understand his condition, and is much more likely to relapse.

But, in any case, it must be noted that the patient relies on the explanation given to him, and that the real cause of the condition may never have been discovered. Treatment by suggestion does not, therefore, conform to our ideal method of treatment, and is not here advocated as such, but it is very useful in practice as a method of removing symptoms in certain cases.

REFERENCES.

[1] BERNHEIM, H. "Automatisme et Suggestion," 1917, p. 55.
[2] *Idem.* "Hypnotisme, Suggestion, Psychothérapie," 1903, p. 24.
[3] FERENCZI, S. "Contributions to Psycho-analysis," 1916, p. 55.
[4] *Idem. Ibid.*, p. 253.
[5] HART, B. *Proc. Roy. Soc. of Med.*, March, 1919.
[6] JANET, P. "Mental State of Hystericals," p. 240.
[7] JONES, E. "Papers on Psycho-analysis," Second Edition, 1918, p. 319.
[8] *Idem. Ibid.*, p. 320.
[9] *Idem. Ibid.*, p. 583.
[10] *Idem. Ibid.*, p. 318, *et seq.*

[11] Le Bon, G. "The Crowd," Eleventh Impression, 1917, p. 32.
[12] McDougall, W. "An Introduction to Social Psychology," Twelfth Edition, 1917, p. 97.
[13] *Idem. Ibid.*, p. 90.
[14] *Idem. Ibid.*, p. 99.
[15] Prideaux, E. "Functional Nervous Diseases," 1920, chap. iv.
[16] Rivers, W. H. R. "Mental Hygiene," 1918, vol. ii, No. 4, p. 519.
[17] *Idem. Ibid.*, p. 529.
[18] Shand, A. F. "Foundations of Character," 1914, p. 422.
[19] *Idem. Ibid.*, p. 260.
[20] Trotter, W. "Instinct of the Herd in Peace and War," Third Impression, 1917, p. 33
[21] Wallace, W. "Hegel's Philosophy of Mind," 1894, p. 167.

LETHARGIC ENCEPHALITIS; ITS SEQUELÆ AND MORBID ANATOMY.

BY E. FARQUHAR BUZZARD, M.D., F.R.C.P.,

AND

J. G. GREENFIELD, M.D., B.Sc.

In the spring of 1918 attention was drawn by Dr. Wilfred Harris and Professor A. J. Hall to the presence of an epidemic disease which has since become generally known as lethargic encephalitis. The disease was prevalent with fluctuating severity until the summer of 1919 and was more or less associated and coincident with a prolonged and severe epidemic of influenza, which also presented marked fluctuations. Many cases of encephalitis were, in their early stages, regarded as cases of influenza, and both diseases were characterized pathologically by the hæmorrhagic nature of their inflammatory lesions. Whether the relationship between influenza and lethargic encephalitis is more intimate than we are at present aware of, or whether their association was purely accidental, are questions which cannot yet be answered.

In the early days of the epidemic lethargic encephalitis was supposed to be characterized by asthenia, lethargy and disorders of ocular movements, but our outlook was rapidly broadened by experience, so that the name now embraces a much larger group of symptoms, which varies with the incidence of the inflammatory process on different parts of the central nervous system.

The following pages contain a recapitulation of the contents of two papers[1] already published, to which have been added the results of some more recent observations and a description of the morbid anatomy of the disease.

It is our purpose here to draw attention to the great variety of symptoms and physical signs which may result from an attack of encephalitis and to the interesting late phenomena which are in many cases a legacy of the disease. That the symptoms of an inflammation of the brain should vary in almost every case is not a matter of surprise; on the contrary, it would be astonishing if inflammation of

[1] (1) "An Address on Lethargic Encephalitis," by E. Farquhar Buzzard, *Lancet*, December 21, 1918. (2) "Encephalitis Lethargica," by E. Farquhar Buzzard, *Proceedings of the Royal Society of Medicine*, August, 1919, vol. xii, No. 9.

an organ, of which the functions are so numerous, did not give rise to a versatile symptomatology.

The diagnosis, therefore, of lethargic encephalitis can never depend on the presence or absence of any symptom or group of symptoms. It must be determined by a consideration of the onset and course of the disease, and by the elimination of other pathological conditions which may produce similar symptoms and physical signs.

We hesitate to make an attempt to describe different types of the disease dependent on the anatomical incidence of the inflammatory process, because the definition is rarely so exact as to deserve it, but we may point to three groups of cases with characteristics sufficiently distinct to merit consideration.

(1) Cases characterized by hemiplegia, hemianæsthesia, hemianopia, &c.

(2) Cases characterized by symptoms resembling those of paralysis agitans; the basal ganglia group.

(3) Cases characterized by disturbances of function of the cranial nerves.

These three groups correspond to different anatomical levels of the brain, and suggest the chief incidence of the inflammation in each, but both clinical and pathological observations show that the disease is always more widespread than might be suspected from the most prominent symptoms.

The first case to be described affords a good illustration of the disease in its acute and fatal form when the chief incidence of the inflammation falls upon the cranial nerve nuclei. There is plenty of evidence, however, to show that other parts of the brain were affected, especially in the early stages of the disease. The lethargy, which is so characteristic of some cases, may possibly be attributed to a condition of hydrocephalus induced by inflammation and œdema in the region of the corpora quadrigemina interfering with the circulation of the cerebrospinal fluid through the aqueduct of Sylvius.

Case 1.—A married lady, aged 27, in the last few weeks of her second pregnancy complained on January 13, 1919, of diplopia and a strange feeling in her head. During the next two days she went about as usual, but appeared at times to be confused, drowsy and unable to remember the object of her shopping errands. On January 16 she had an easy and uncomplicated confinement. On January 17 her temperature gradually rose to 104° F., headache was severe and there was increasing drowsiness and disorientation. On examination she presented partial bilateral ptosis, weakness of the left inferior rectus muscle,

an expressionless face, slight tremor of the tongue and hands, with normal tendon jerks and doubtful plantar responses. The next day she was more drowsy and asleep all the time unless she was roused. The ptosis was more marked and the temperature remained between 103° F. and 104° F. The optic discs were slightly congested. A papular rash had appeared over a large part of the surface, particularly over the forearms, buttocks and anterior aspects of the legs. A lumbar puncture obtained cerebrospinal fluid in which no abnormal cells could be detected. On January 20 the patient was much worse. She lay in a muttering delirium, cyanosed, picking at the bedclothes, with a pulse of 140, mucous râles in the chest, rapid respiration and an intense general morbiliform rash. There was now complete ptosis and palsy of all ocular movements. Swallowing had become impossible and the patient resented light thrown into her eyes. Death seemed imminent, but during the next forty-eight hours there was a remarkable rally. The temperature fell, the rash faded, pulse and respiration improved, but the ocular palsies and the dysphagia remained. At this time involuntary local spasmodic movements were very noticeable in the limbs. On January 23 the temperature was below normal and the patient had spoken a few words quite rationally and asked after her baby. Swallowing was again possible, but the eye movements were no better. The same night, however, the temperature shot up to 104° F., the rash reappeared in a still more intense form, and the patient went rapidly downhill, dying on January 25.

This case was remarkable for the pyrexia, for the rash which challenged comparison with a very severe measles eruption and for the occurrence of a fatal relapse, falsifying the apparently justifiable hopes of recovery which were entertained two days before death.

The next two cases illustrate the rare occurrence of two members of the same household contracting the disease. In both patients, a mother and her son, the symptoms pointed to an affection of the hemispheres, and signs attributable to the involvement of cranial nerve nuclei were absent.

Case 2.—The son, aged 19, came home from a theatre on March 28, 1919, suffering from headache and feeling feverish. The next day his temperature rose and on March 30 a rash appeared, giving rise to a suspicion of scarlet fever. The following day headache was severe and the patient had a sudden generalized convulsive attack which left him in a semi-comatose condition. When seen on April 1, he lay half unconscious with closed eyes and displaying a marked resentment to all examination or disturbance. The right arm was obviously paralysed, the abdominal reflexes were sluggish and the knee-jerks difficult to obtain. A lumbar puncture released fluid at increased pressure. The only abnormality detected on complete examination was an increase in the glucose content. The patient recovered consciousness a few hours later and was found to have difficulty in speaking and to have weakness of the right

side of the face and of the right arm and hand. From that time recovery was progressive and uninterrupted, but at the end of a fortnight the weakness of the face and grasp was still perceptible.

Case 3.—On April 14 the mother, aged 54, who had been much with her son, began to feel as if her tongue and throat were swollen and complained of headache. The next morning headache was severe, the temperature was 101° F., and the patient displayed an intense morbiliform rash all over the chest, abdomen and arms. Photophobia and vomiting added to her discomfort. The cerebrospinal fluid was at high pressure and resembled the specimen obtained from the patient's son except for a slight increase in the percentage of chlorides. The patient suffered from the headache and vomiting for two days and during the same period exhibited weakness of the left side of the the face and of the right arm, but her recovery was more rapid than that of her son.

During the last two years a number of cases of encephalitis have been observed which form a marked contrast to the severe type just described, and many of which have never been considered or have never considered themselves as seriously ill. This group is characterized by the insidious onset of slight lethargy, an inclination to fall asleep whenever they sit down to rest or read, or a tendency to forget the small things of everyday life, and sometimes by an alteration of temperament. The patient may complain of diplopia which lasts for a few days to a few weeks, or of a general stiffness or slowness in his movements. He may complain that although he is always dropping off to sleep in the daytime his night's sleep is disturbed by restlessness, by mild cramps or pains in his limbs, so that he wakes every hour or two. Headache may never be complained of and fever may be conspicuous by its absence.

Case 4.—A recently married lady of 27 was seen in consultation because she was always dropping off to sleep and complained of double vision. She had a slight feeling of nausea and said her head felt "buzzy." She stated that she had gone to the butcher's and left her coupon as well as her meat. On examination the left palpebral fissure was wider than the right and diplopia was obtained on directing the patient's eyes to the left. She had no other physical signs and she made a complete recovery in the course of a fortnight or three weeks, but the precaution was taken of sending her to bed for a rest. Her symptoms were almost identical with those of Case 1 in the first few days of her illness, and it was impossible to say whether the more serious and fatal sequelæ might not supervene.

Case 5.—In February, 1919, a man aged 59 stated that in December, 1918, as he was walking to catch his morning train to the City, he noticed "every-

thing looking double," and that in the course of a week he became stiff all over, "making me feel like an automatic figure in my movements." He had no headache but felt very sleepy and could not keep awake when reading. His appearance suggested the diagnosis of paralysis agitans, judging by his mask-like face, the gait, and the way in which he held his arms and hands. He complained of slight twitches at times in his hands and particularly of the slowness with which he dressed and undressed. The diplopia had cleared up and he was improving in every way. When seen again in April he was much better and could then write freely and dress himself in normal time.

Case 6.—On February 11, 1918, a lady aged 53 complained for a fortnight of slight headache and sleepiness. On January 31 she had developed diplopia, increased drowsiness and mental disorientation with a slight degree of ptosis. She was restless and unable to concentrate her attention. She presented slight weakness of the right side of the face and the right hand tended to assume the paralysis agitans position with occasional twitching of the fingers.

There were no other physical signs, but the temperature was apt to reach 100° F. on some days. This lady's progress towards recovery has been very slow, especially in regard to her mental condition. She is still depressed, easily exhausted and unable to keep her interest or attention fixed for any length of time.

Case 7.—A lady aged 46, after feeling seedy for two or three weeks, was seized on March 30, 1919, with some headache and vomiting and pyrexia which lasted for several days. Photophobia and bouts of drowsiness with a milder degree of headache persisted after the fall of her temperature. On examination she presented a slight degree of ptosis on the right side, absence of all abdominal reflexes and sluggish tendon jerks. She made a good but slow recovery.

Case 8.—A gentleman, aged 63, in March, 1919, complained that a week before the consultation he was seized with diplopia while playing billiards. This was followed by headache and general restlessness, a little cramp in the legs and paræsthesiæ in both hands. He presented partial ptosis, more marked on the right, and weakness of all ocular muscles, especially in regard to the internal and vertical movements. The right pupil reacted sluggishly to light. The knee and ankle jerks were difficult to obtain, and the right plantar reflex was indefinite in type. In spite of the comparative severity of his symptoms this patient made a rapid recovery in the course of a fortnight, during which time he was kept in bed.

Case 9.—On June 6, 1919, a lady, aged 42, stated that two months previously she had been suddenly seized with diplopia, drowsiness, general loss of power, loss of memory and loss of control over her emotions. She stated that she felt as if she was in a dream and that, whereas she had always been lively and bright, she was now quite altered in temperament and

only wished to go to sleep. She had not suffered from headache or vomiting, and as far as she knew had had no rise of temperature. On examination her pupils were found to be sluggish, there was left-sided ptosis and paresis of the left internal rectus muscle. Her face was expressionless and her movements generally feeble, but the reflexes were normal. It may be noted that she had never been laid up in bed, and that she had been medically advised to go about as much as possible and to seek lively company.

These cases of mild encephalitis could be multiplied, but a sufficient number have been described to indicate their general symptomatology and physical signs and to support the view that they must have been very numerous during the last two years. The physical signs have been generally trivial and would easily have escaped notice with any but careful examination. The histories obtained from the patients and the account of their symptoms have been important factors in the diagnosis, which has been confirmed by the general tendency towards recovery in the course of a few weeks or a few months. One can hardly doubt that early diagnosis is a matter of great importance in these cases, and that patients who are suffering from an inflammation of the brain should be prevented from carrying on their normal activities even though they are not troubled with headache, vomiting or pyrexia.

Attention must now be drawn to another very interesting and serious aspect of the more severe cases of encephalitis who recover from the acute stage of the disease, but who are overtaken by more or less disabling sequelæ at varying intervals of time. We refer to the late development of involuntary movements affecting the limbs, jaw or tongue. Some of these patients have passed through an acute illness associated with severe headache, vomiting, fever and other cerebral symptoms which have given rise to the diagnosis of influenza, meningitis, &c. Some of them have displayed involuntary movements during the acute disease, the abnormal activities disappearing in the course of a long convalescence. It would be difficult to describe accurately the character of these movements; some have been irregular and choreiform, others more rhythmical and limited in their distribution. One of the patients had movements confined to the left foot which she aptly nicknamed her "joggles." Speaking generally the movements are in abeyance while the parts concerned are in voluntary use and are most obvious when the patient is resting. On the other hand, all these movements cease during sleep and gradually subside in the process of going to sleep. The movements do not interfere with voluntary action and are only a source of complaint in that they disturb the patient's peacefulness while at rest.

Case 10.—W. H., aged 28. A fireman on the Great Eastern Railway. Family and previous history good in all respects. He was taken ill on June 4, 1918, and went to bed on June 6 with headache, general malaise and sleeplessness. The right side of the face became paralysed, there was difficulty in mastication and fluids regurgitated through his nose. The latter symptom only lasted about ten days, but by June 27 he displayed tremor of his right hand in shaving and writing and his legs appeared to be weak. His reflexes at that time were normal. During the next six months he made little or no progress towards recovery and by December his legs were showing involuntary movements which spread to the left arm early in 1919. When admitted into the National Hospital in April of this year he displayed constant movements of both shoulders more marked on the left side. The movement of the left arm may be best described as "trouser hitching" and included contractions of the deltoid, latissimus dorsi, trapezius and biceps muscles. There were also forced movements of the head chiefly carried out by the deep muscles of the neck. In the legs contractions of several groups of muscles were obvious while he lay in bed, but these were suspended during walking or other voluntary movements and during sleep. The pupils were dilated and unequal, the left being larger and less active to light than the right. The right side of the face was weak in voluntary action, but at rest showed an increase of tone and clonic spasms.

The strength of the limbs appeared to be about normal, but when the arms were outstretched there appeared coarse movements at the shoulder which were increased by fatigue. The arm movements showed some dysmetria and dysdiadochokinesia. The reflexes were normal in all respects.

During the last three months the patient has shown marked improvement. His blood and cerebrospinal fluid have been examined with negative results.

Case 11.—J. W., aged 44. A packer. Seen for the first time on June 1, 1919, at St. Thomas's Hospital, when he stated that six weeks previously he had noticed diplopia, mental confusion and tremor of his right arm and right leg. He presented a typical paralysis agitans appearance in posture and facies. The reflexes were normal. A month later he complained of increased tremor in the right hand and dragging of the right foot and constant twitching of the muscles of the right thigh. In July and August he was improving. In November he was walking more freely but displayed coarse involuntary movements of the right hand. In January, 1919, there were continuous involuntary movements of the jaw and tongue which were suspended during talking and eating. During the last six months these have gradually decreased and are now hardly noticeable. He expresses himself as very much better in all respects, but his resemblance to a case of Parkinson's disease is still obvious.

Case 12.—A. M. P., a married woman, aged 35. Sent to the National Hospital by Dr. Davidson, who kindly supplied the following note dated November 20, 1919: "Illness started in February, 1919 (when she was

seven months pregnant), with acute pain down the left arm. Two or three days later I was sent for and found her sitting in a chair, twitching all over, muttering to herself and only semi-conscious. The movements were choreic, and I thought at first it was a bad attack of chorea gravidarum. I got her into the local infirmary, where she lay unconscious for several days and miscarried. She was discharged from the infirmary about a fortnight ago, but although her mind is clear she is scarcely able to walk and is on the twitch all day long."

On examination she showed constant involuntary movement of internal rotation of the left shoulder with flexion of the left elbow. The trapezius and pectoral muscles also took part in this movement. The right arm was similarly affected but to a less degree. Tendon-jerks exaggerated. Left plantar response was extensor, right flexor. No sensory disturbance. Slight diplopia has been present but has now cleared up.

Case 13.—L. F., a single woman, aged 28. Suffered from chorea as a child. Seen on April 4, 1919, at the National Hospital, when she gave the following history:—

A year ago she went to the doctor with a sore throat and headache and felt faint on her return home, when she lost power in her left arm and leg. This gradually recovered, but left her with involuntary movements in her left leg and some tremor and unsteadiness in her left arm and hand.

On examination the right pupil was larger than the left. The left abdominal reflex was absent, the left knee-jerk more brisk than the right and the left plantar reflex indefinitely extensor in type. The left foot was in a state of constant movement while sitting, but quite steady when she was walking or standing. She has an old mitral lesion and it is possible that her condition is due to an embolic lesion.

Case 14.—A man, aged 52, with a history of good health, was seriously ill for six weeks in May, 1918, with what was called "influenza." During a part of this time he was unconscious and he had never felt strong since his recovery. About September, 1918, he noticed involuntary twitching of the right toe which spread until it affected the greater part of the right leg and right shoulder.

When seen at the National Hospital in December, 1918, he was found to be well nourished and of normal intelligence. His arteries were somewhat thickened and tortuous, but the heart and other organs were healthy. The Wassermann reaction of the blood and cerebrospinal fluid was normal. Nothing abnormal was detected in the function of the cranial nerves.

When standing the patient displayed involuntary movements of the right upper limb produced by contractions in the right trapezius, rhomboids, spinati and deltoid. The movements recurred at intervals of one to two seconds and the right arm was thrown behind the trunk and slightly elevated with each spasm.

The left erector spinæ was sometimes contracted at the same time and the right abdominal muscles in such a way that there was an irregular rotatory

movement of the abdominal wall and umbilicus. Clonic contractions occurred in the muscles of both buttocks and in most of the muscles of the right thigh and leg when the patient was at rest. All voluntary movements could be performed with good power and the involuntary movements could be controlled by voluntary effort, at any rate for a time. There was no disturbance of sensibility and all reflexes were normal. The movement in the right arm bore a strong family resemblance to that seen in Case 10.

Case 15.—This patient, a young man who was seen by the courtesy of Dr. Head in November, 1919, was then 28 years of age. He stated that he was quite well until March, 1916, when he had a serious illness which was described as influenza. During part of that illness he was unconscious and catheterization was necessary. During convalescence he was very weak on his legs and found some difficulty in articulation, and a few weeks after returning to work he developed a tremor which affected the greater part of his body and which was increased by emotion, fatigue or any sustained effort. This tremor has been gradually disappearing and becoming more limited. On examination I found him slightly lacking in facial expression, but otherwise the functions of his cranial nerves appeared to be normal. Under observation he showed an irregular rhythmic movement of his trunk, and when he was stripped and lying on his back on a couch it was possible to analyse the muscles which were concerned in the involuntary movement, especially when he was asked to raise one leg off the couch and sustain it in that position against resistance. Such an effort produced a rhythmical contraction of the oblique muscle in the left flank as a first and minimal effect, but this was quickly followed by rhythmical contractions of the left latissimus dorsi and of the left erector spinæ, a muscle which appeared to be in a state of slightly increased tone even while he was standing with his feet together. When the involuntary movements became intensified they were apt to spread to other muscles on the other side of the trunk. The tendon-jerks were normal, the plantar reflexes flexor in type, but no abdominal reflexes could be obtained.

Case 16.—A man, aged 30, was seen at the National Hospital on January 1, 1920, when he stated that in December, 1918, he was in another London hospital seriously ill with a disease diagnosed as encephalitis lethargica. He made a fairly good recovery and was working at a light job for eight months during 1919, but in December of that year there was a marked increase in the stiffness and disabilities of his left limbs so that he was obliged to give up his work. On examination he presented the appearance of paralysis agitans in regard to his facies and general posture. His articulation was rather hesitating and there was some vertical and lateral nystagmus. He described his left hand as being always cold and had noticed occasional twitches in it. All reflexes were normal.

This patient's history is recorded because he illustrates the occasional relapse of symptoms occurring months after the original illness, and the

fact that this relapse is not always represented by involuntary movements but sometimes by an intensification of rigidity and paresis.

It would, of course, be impossible to provide scientific proof that each and all of these patients have suffered from lethargic encephalitis, but circumstantial evidence is strongly in favour of this hypothesis. Involuntary movements have been frequently observed during the acute stage of the disease, but the chief interest of several of the cases here described attaches to the development of movements weeks or months after convalescence has become established.

Following the common encephalitis of infancy and childhood athetosis and choreiform movements associated with some degree of hemiplegia or diplegia are occasionally met with, but so far we have not seen true athetosis as a sequel to the lethargic variety. This difference may depend on the age of the patients or upon some difference in the pathological results of the inflammatory lesions. Reference will be made later to the degenerative changes which we have found in the cerebral blood-vessels in cases of lethargic encephalitis some weeks or months after the acute illness.

In the present state of our knowledge it is difficult to correlate the occurrence of involuntary movements with any local lesion, and it is more difficult to determine whether the former are the result of some chronic irritation or whether they represent the release of some nervous activity by interference with control. The latter theory is, in our opinion, the most probable, especially in view of the fact that these movements can be temporarily controlled by the patient and generally cease when the affected part is being voluntarily employed.

So far as treatment is concerned we have seen no good results from drugs, massage or electricity, but improvement has generally taken place while the patient has been encouraged to re-educate his control over the movements, and the prognosis is favourable even when the distressing symptoms have been present for many months.

The next four cases described belong to Group I, and serve to emphasize the difficulty in diagnosis, especially in regard to the possible presence of cerebral tumour, cerebral abscess or cerebral hæmorrhage.

Case 17.—On Thursday, March 28, 1918, a lady, aged 54, noticed that her right hand was rather shaky. The next day she went away for the Easter holidays, but returned on the Sunday on account of the uncontrollable jerking of her right arm and hand, which gradually became worse and spread to the whole of the right side. When seen on April 5 there was a mixture of clonic

and tonic spasm, affecting the whole of the right side, with considerable impairment of voluntary movement and more or less complete aphasia. The reflexes on the affected side were of the usual hemiplegia type, whilst those on the left side were normal. There were a few movements noticed in the left arm, but there were no cranial nerve disorders beyond the weakness of the right side of the face. There was no optic neuritis and nothing in the cardio-vascular condition of the patient to explain the symptoms.

The movements soon ceased, but she became completely hemiplegic on the right side, completely aphasic and incontinent. She appeared to be perfectly conscious, although unable to say a word or to make much response to orders. About a fortnight later she was admitted into the National Hospital, Queen Square, where she gradually became more comatose and died on May 9, exactly six weeks from the onset of her illness. The early stages of this illness were afebrile and no abnormal condition was found in her heart, lungs or kidneys. During the last few days of life her temperature varied between normal and 102° F., and at that time there was some albuminuria.

At the post-mortem examination the surface of the brain was noticeable for the presence of some dark reddish-brown staining in the subarachnoid space, evidently due to slight hæmorrhage on the surface of the cortex. This was most marked over the parietal lobe on the left side, but there were small patches scattered here and there in other parts of both hemispheres. Sections of this brain presented all the characteristic appearances of a hæmorrhagic encephalitis without the occurrence of any large hæmorrhage.

Case 18.—The patient was first seen on May 6, 1918. She was aged 44, and complained that she had not been feeling well for some time, but she had had nothing particular to complain of until Thursday, May 2, when she had some difficulty in doing her work owing, as she explained, to a deficiency in her mental grasp. On the following day she displayed some awkwardness and clumsiness in her right hand, and on the third day the whole of the right arm was weak. On this day she had an epileptic attack, involving and confined to the right side of the body, and this attack was repeated at intervals on the Sunday and Monday, with the result that she became more and more hemiplegic, more aphasic, and distinctly drowsy. She vomited on one occasion.

On the Monday evening she lay in bed in a lethargic condition, unable to speak, but evidently able to understand some commands, and able to indicate when she wanted to perform natural functions. She was taking her food well, and had little or no rise of temperature. There was complete right hemiplegia with the usual reflexes, some right hemianæsthesia and complete right hemianopia. Her condition remained much the same during the next two days, and a lumbar puncture was performed, the fluid removed being at increased pressure but quite clear, and on microscopical examination normal in its cytology. The Wassermann reaction was negative. At this time she appeared to be suffering from severe headache, and on Thursday mid-day she was distinctly more stuporose, had become incontinent, was swallowing with

difficulty, and showed some tendency to ptosis in both eyes. For the first time the optic discs showed slight swelling and blurring of the upper and inner edges.

She was obviously suffering from increased intracranial pressure, and a decompressive operation was decided upon. This was carried out by Colonel Sargent at 10 o'clock in the evening. She was trephined over the left post-central and temporal regions, and as soon as the bone was removed it was noticed that the dura was bulging, very thin, and easily torn. The brain surface presented a dark purple colour through the dura, and, on opening the latter, there was found great increase of tension. Shreds of recent clotted blood were scattered about, both beneath the dura and in the subarachnoid space. The cortex was hyperæmic and easily ruptured. The post-central vein was firm and thrombosed, and towards the vertex of the hemisphere the brain matter was deeply blood-stained and partly disintegrated. A sample of blood was taken up in a sterilized pipette for culture purposes, but nothing was grown from it. The patient died the following morning, and the post-mortem examination was made the next day.

The brain had on casual inspection the appearance of one from a case of cerebral hæmorrhage, but closer investigation revealed the presence of thrombosed veins on the surface of the left hemisphere, and one or two patches of what looked like hæmorrhagic infarction on the opposite side. After hardening, sections through the organ showed the presence of widespread encephalitis, confirmed by microscopical examination. All parts of the brain were not equally affected, and it has been characteristic of most of these cases that the inflammation has been patchy in its distribution—although there has generally been one large focus where the process has been most intense and most hæmorrhagic.

The account of this case is particularly interesting when compared with Case 3.

Case 19.—This patient was first seen on July 24, 1918. His age was 58, and he had always enjoyed good health until about three months previously, when he began to show forgetfulness and to do odd things, such as leaving off an article of his usual clothing. About the same time he began to complain of headache. For about a month there must have been some difficulty of sight, as his attempts to play croquet—at which he had been quite good—had become laughably bad. On Thursday, July 18, he had stayed away from business, not feeling well, and on Saturday he vomited incessantly, and complained of severe headache and pain in his legs. His temperature was about 100° F. on Saturday and Sunday, and on Monday he became distinctly worse, more drowsy, and somewhat aphasic. On this day right hemianopia was detected. On the Wednesday he was lethargic, and obviously very ill. His pupils were active. Both discs were slightly swollen with engorged veins, but no marked neuritis. There was complete right hemianopia associated with object blindness. He was quite unable to name objects, although he seemed to appreciate what they were

when he saw them. If a key was put in his right hand he used it in a normal fashion, but he could not name it. He had obvious difficulty in understanding what was said to him, and made mistakes in carrying out orders. His temperature was then normal. There was no actual paralysis, the knee jerks were rather sluggish, the right being more brisk than the left, and on the right side an extensor response could be elicited. The blood and cerebro-spinal fluid were examined. The blood-count was practically a normal one and there was certainly no marked degree of leucocytosis. The cerebro-spinal fluid contained a considerable quantity of blood, and in addition there were some cells showing fatty degeneration which were not of blood origin.

The patient showed no signs of improvement, and it was decided that an operation for the relief of pressure should be undertaken. This was carried out by Colonel Sargent on August 1st, when he exposed the brain in the left post-central and occipital regions. Intracranial tension was increased, and the dura before being opened looked plum-coloured and opaque. When incised it appeared that there had been slight patchy hæmorrhage between its layers, and the cerebral surface was stained yellow. Blood was present in small quantities between the dura and the pia mater, here and there as a thin film and clot, elsewhere as darkish fluid blood. The fluid part had evidently sunk down towards the base, for on retracting the lower part of the exposed brain dark blood welled up in considerable quantity. The convolutions were flattened and pale, and here and there were lengths of thrombosed cortical veins. Just below the posterior end of the first temporal convolution was a spot which showed considerable softening, but there was no evidence of tumour or abscess anywhere. The patient stood the operation well, but was very restless during the following night, and later became almost maniacal. He began to refuse food, and his bladder had to be emptied by catheter for a couple of days. The headache was much relieved by the operation, but the patient gradually became more comatose, and died about ten days later. There was no post-mortem examination in this case, but no doubt can be entertained as to the diagnosis of lethargic encephalitis in view of the clinical history, and of what was seen at the operation.

Case 20.—The patient was a man of about 50 years of age, first seen on September 15, 1915. There was a history that early in August when working in a field in the country he had fallen down unconscious, had been delirious for a few hours, was seen by a doctor, and diagnosed as sunstroke, and that he continued to complain of headache and vertigo. He remained in a stationary condition until about September 13, when he was seized with very severe pain in the head, had several epileptiform convulsions, and, on examination, presented evidence of slight hemiplegia and some hemianopia. He was drowsy and difficult to examine, but he showed no signs of cardio-vascular disease, and his optic discs presented no change. The urine was normal. He was moved into St. Thomas's Home on September 16, and a lumbar puncture was performed on the same day. Very soon after this operation he had a general convulsion, and died quite suddenly.

The post-mortem was made the next day, when the brain presented the naked-eye appearances of cerebral hæmorrhage without any evidence of arterial changes. Portions examined microscopically displayed the characteristics of encephalitis.

The story of these four cases, coming so close together, appears to me to be one of unusual interest. All four patients were over 40 years of age, but none of them presented cardio-vascular changes suggesting the possibility of cerebral hæmorrhage as a diagnosis. In none of the four cases did the clinical history conform closely to that of cerebral hæmorrhage, but suggested some more subacute lesion, and naturally gave rise to the question of abscess or syphilitic thrombosis. In all four cases the Wassermann reaction and other features of the cerebrospinal fluid were negative. The lesson learnt from this experience is that patients over 40, and even over 50, years of age, may be the victims of encephalitis, producing the general symptoms of hemiplegia, aphasia, hemianæsthesia, or hemianopia. In the second place it seems that a naked-eye examination of a brain on a post-mortem table is not sufficient to discriminate between an ordinary cerebral hæmorrhage and a hæmorrhage which is only an accidental occurrence in the course of an encephalitis. It teaches us that when there are no obvious gross signs of disease in the cerebral arteries to account for a hæmorrhage, it is essential that microscopical investigation should be carried out in order to determine the cause for the blood extravasation. Thirdly, we must look on the presence of thrombosed cortical veins associated with hæmorrhage in the neighbouring brain substance as strongly indicative of an inflammatory process.

There is no reason to suppose that lethargic encephalitis is a new disease, and we may justifiably assume that endemic cases occur from time to time. Most of us can recall patients suffering from symptoms of acute or subacute cerebral disease, in connexion with whom a hesitating diagnosis of cerebral hæmorrhage has been made, and others again of whom a diagnosis has never been properly established. This recent epidemic is of practical importance in that it ought to bring the possibility of encephalitis more prominently before our minds in cases of cerebral disease presenting difficulties in diagnosis. At the present moment this realization may not be of much practical importance, because we are not yet in a position to say what is the nature of the infection, or to point to any method of treatment likely to abort or cure the disease. The experience of these four cases, however, suggests that operative intervention in the way of decompression is really contra-

indicated, in spite of the presence of increased intracranial tension. Three of these patients died partly, at any rate, from hæmorrhage, and it is hard to believe that decompression can be beneficial when this hæmorrhagic tendency exists.

Further experience may teach us more about the prognosis in this disease. At present we can only say that some cases recover completely, others survive the acute stage, but carry with them in after-life permanent defects due to the morbid process, while a certain number die either from toxæmia or hæmorrhage in the acute illness or from some complication following it.

Pathological Findings in Fatal Cases.

Case 17.—*Cortex.*

The meninges show a moderate degree of infiltration with small round cells, more diffuse and less in degree than over the brain stem. The vessels are all greatly engorged, even the smallest capillaries being distended with blood. There is much perivascular infiltration round almost all the vessels, especially the venules. The nerve cells show little change beyond an excess of pigment. Their Nissl granules are well stained, and there is comparatively little neuronophagy. The most striking change is multiplication of glial cells, very many of which have assumed the large "amœboid" type, with one or more large eccentric nuclei, which often contain more than one nucleolus. These cells are grouped in clusters in the neighbourhood of medium-sized vessels in the subcortical layer. By Alzheimer's "fuchsin and light green" method the cytoplasm of these cells is seen to be continued into processes which run for some distance as a definite strand from the cell body before becoming merged in the general glial network. No fuchsinophil or other granules were seen in these glial cells by this method. This glial proliferation is of greater degree in this case than in any of the others.

Midbrain.—Here the perivascular infiltration reaches a maximum for the brain stem. Almost every small vessel has a smaller or larger cuff of small round cells, and in addition there is a patchy infiltration of the nervous tissues with similar cells. The increase of nuclei along the capillary walls is also much in evidence, and fairly general.

The meninges also show a small-celled infiltration particularly dense in occasional patches near medium-sized vessels. Except for an occasional vein in which a recent clot is seen, there is no evidence of vascular

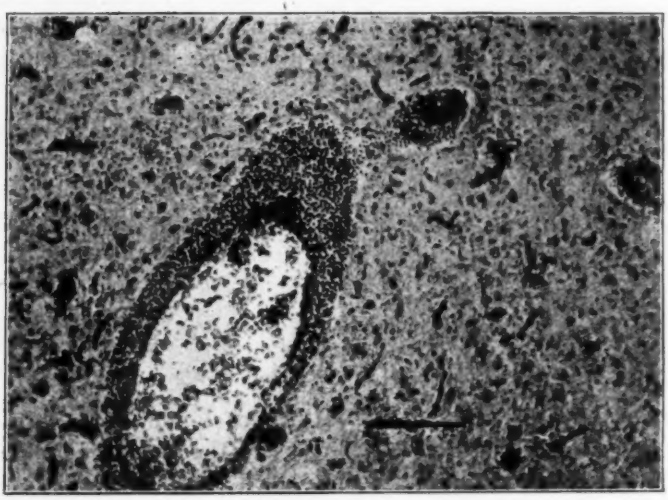

FIG. 1.—Case 17. Cortex. The typical "cuffing" of the medium and small-sized veins of the cortex is shown, as well as the great congestion of the capillaries. (Zeiss 16 mm. obj. Comp. ocular No. 4.)

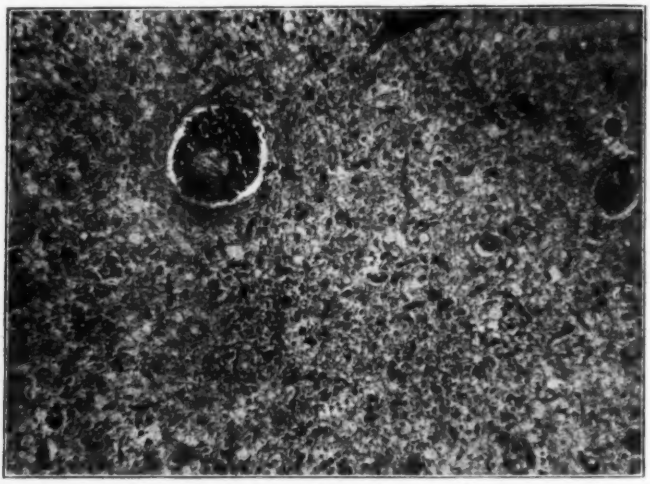

FIG. 2.—Case 17. Cortex. A vessel is seen with a fibrinous clot in its lumen, and surrounded by a thick ring of small round cells. Great glial overgrowth is seen in the surrounding nervous tissue. (Zeiss 16 mm. obj. Comp. ocular No. 4.)

thrombosis. The nerve cells show greater changes here than elsewhere in the brain stem. Chromatolytic changes are common and fairly severe, especially in the nucleus oculomotorius, where many cells show eccentricity of their nucleus and an excess of pigment, with a few Nissl granules round the periphery of the cell. Still more noticable is the excess of small cells of glial or mesodermal origin, around the cells of the oculomotor nucleus. This is seen also among the cells of the substantia nigra, where there is a very general infiltration of the tissues with small mononuclear cells. The cells of the substantia nigra, however, are for the most part normal, and have very well stained Nissl granules.

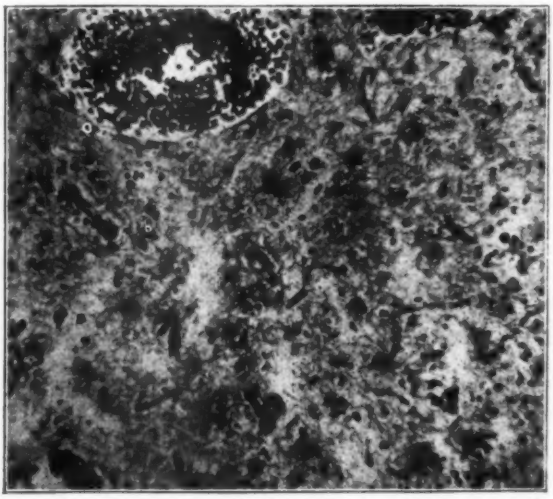

FIG. 3.—Case 17. Cortex. A vessel is seen showing considerable small round-celled infiltration of its sheath. There is great glial proliferation leading to the appearance of large binucleated glial cells. (Zeiss 8 mm. obj. Comp. ocular No. 4.)

The cells of the mesencephalic root of the fifth show no abnormality.

Pons.—In the lower part of the pons the changes are not very striking except immediately under the floor of the fourth ventricle, where a few vessels are seen with hæmorrhages into the tissues around them, as well as a slight degree of small-celled infiltration in their sheaths. In these vessels the small cells are not seen outside the adventitial coat, but infiltrate the meshes of the Virchow-Robin space. The hæmorrhage is almost entirely outside this, and breaks up the glial network, or tears it away and pushes it back from the vessel walls. The

stretching which the glial fibres undergo in this process is evidenced by a tangential concentric arrangement of the innermost glial layers (see fig. 11). Many of the nerve cells show a moderate degree of chromatolytic change, and some have a few phagocytic cells in relation to them.

Upper part of medulla (at level of olivary body and nucleus of twelfth).—Here the meninges have undergone a general but slight infiltration with lymphocytes and plasma cells. This is greatest in the immediate neighbourhood of the vessels. Several vessels in the posterior part of the medulla around the twelfth nucleus and under the floor of the fourth ventricle show considerable adventitial infiltration. In some vessels this is represented by two crescents of small round cells on the opposite sides of the vessel wall, the intervening space being clear. In others the adventitial infiltration is more general. Most of the nerve cells of the twelfth nucleus are healthy, but in some the Nissl granules are in a powdery condition, and one or two "parasitic" cells are seen in contact with the nerve cell body. These are sometimes glial cells, but often appear to be of fibroblastic origin, having long nuclei, the ends of which are rounded. Others are typical plasma cells. Some of the smaller nerve cells in the same region illustrate a greater degree of the process of neuronophagy; their protoplasm has almost disappeared, and four, five or more small round cells have settled down in close contact with them.

The cells of the olivary nucleus appear fairly healthy. There is a general increase of cells in the interstitial tissue, especially in the posterior part of the section. This is largely accounted for by the emigration of plasma cells and other mesodermal cells into the nervous substance. There is also a certain amount of glial increase, but this has not reached the same profusion as in the cortex.

Medulla (level of decussation of pyramids).—Here there is a patchy infiltration of the meninges with small round cells, among which are many plasma cells and a few polymorphonuclear leucocytes. This occurs chiefly in the neighbourhood of the meningeal vessels. At this level a few vessels in the medulla are surrounded with a thick ring of small round cells. In many other vessels the same infiltration of the adventitial sheath is seen, but to a less degree. There is also an increase of cells, mainly small round cells along the walls of some of the capillaries, but this is not very general. The majority of the large nerve cells of the anterior horn at this level show no abnormality beyond a moderate excess of pigment.

Case 18.

Cortex and meninges.—A few of the medium-sized vessels on the surface of the brain have undergone thrombosis. In the case of a thrombosed vein of medium size (fig. 4) lying in a sulcus of the cortex, the underlying brain matter of the subcortical layer is ploughed up with hæmorrhages, most of which are of very small size but confluent, so that in places little evidence is left of brain tissue. In what is left almost all the small vessels are thrombosed, and there is a great increase in the number of glial nuclei. There is also a proliferation of cells along the walls of the capillaries. There is in this region no infiltration of the vessel sheaths with round cells.

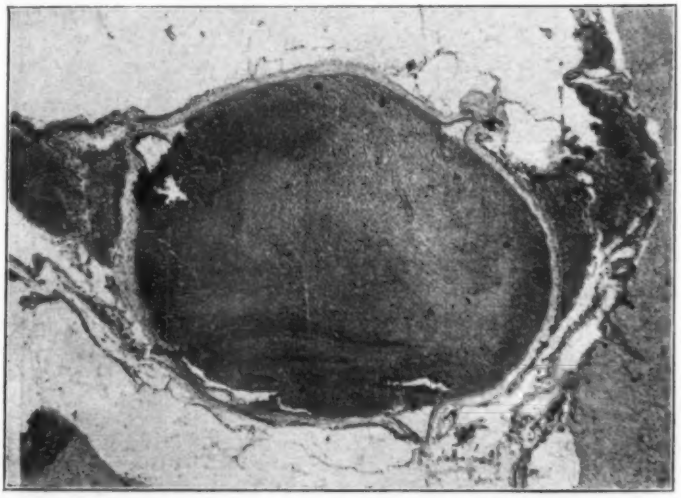

FIG. 4.—Case 18. Large cortical vein completely thrombosed. (Magnification × 35.)

The arachnoid space round this thrombosed vein is full of red blood corpuscles, among which are many polymorphonuclear and mononuclear phagocytic cells.

In another part of the cortex there is an artery lying in a sulcus which has an extensive hæmorrhage into its walls on one side, and a mass of phagocytic cells encroaching on its lumen on the other side. The cortex on one side of this sulcus is almost completely necrosed, showing a wedge-shaped area of diffusely staining tissue in which only a very few palely staining nuclei are seen, along with very numerous

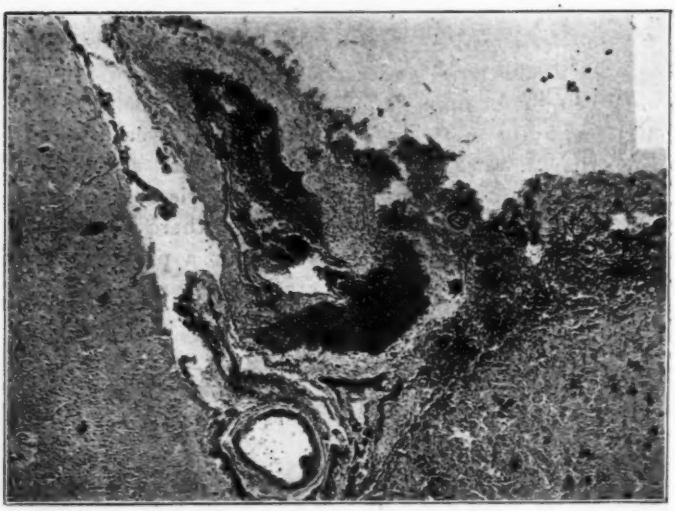

FIG. 5.—Case 18. Medium-sized artery on the cortex partially obstructed with hæmorrhage in its walls, and leading to small wedge-shaped area of infarction, a corner of which is seen in the right lower corner of the figure. (Magnification × 35.)

FIG. 6.—Case 18. View of wedge-shaped area of infarction caused by obstruction to cortical artery seen on surface. (Magnification 10 diameters.)

petechial hæmorrhages and a few phagocytic cells. This area is delimited on one side by the sulcus, and on the other by a fairly sharp line along which runs a thin zone of softened brain tissue containing many compound granular corpuscles, and numerous smaller rounded and elongated cells. This zone shades off into fairly normal brain tissue through an intermediate zone in which the nerve cells are more or less degenerated, and there is great increase in the glial elements. The vessels in this zone have their adventitial spaces filled with phagocytic cells from the degenerate area, but otherwise show no change. This zone shows many newly formed glial fibrils arranged tangentially to the degenerated zone. (See figs. 5 and 6.)

In this area there is considerable hæmorrhage into the meninges, and the blood is being absorbed by large phagocytic cells.

Optic Thalamus.

Vessels.—There is only very slight increase in the number of cells in the adventitial sheaths and many vessels show no change at all. There is everywhere an increase of cells along the small capillaries, showing in many places as chains of three or four small rounded nuclei. There are a very few perivascular hæmorrhages.

Nerve cells.—Most of the larger nerve cells of the thalamus show a great excess of pigment and some perinuclear chromatolysis. A great number of the cells are surrounded with two or more phagocytic cells. The glial cells are everywhere increased in number.

Midbrain and pons.—Here the changes are similar in character to those seen in the thalamus but less definite. There is a very slight increase in the number of cells along the walls of the capillaries and smallest arterioles and venules, and an increase of pigment with some neuronophagy in the nerve cells of the oculomotor nuclei.

Medulla.—No definite changes can be made out here except a slight infiltration of the meninges with small and larger mononuclear cells.

Case 20.

Pieces were taken from the neighbourhood of the hæmorrhage into the basal ganglia and from the cortex.

Meninges.—In several places there are small subarachnoid hæmorrhages. Here, in addition to the red blood corpuscles, there is a considerable degree of small-celled infiltration. A few of the smaller meningeal vessels are thrombosed, their lumen being filled with phagocytic cells, a considerable proportion of which are polymorpho-

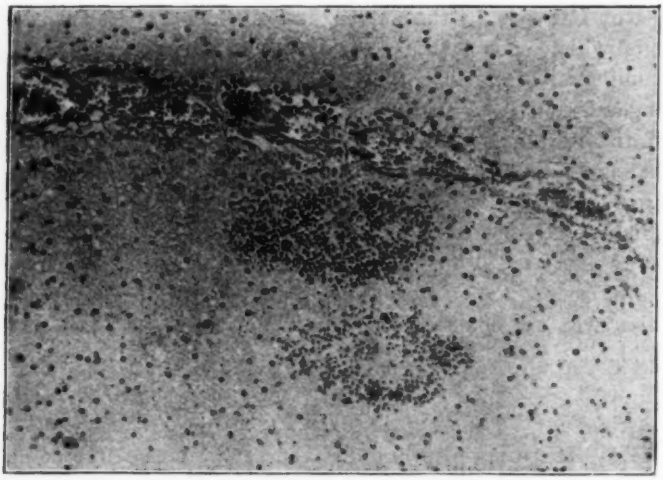

FIG. 7.—Case 20. View of longitudinal section of a small blood-vessel in the cortex. The adventitial sheath is seen to contain numerous small round cells. Two petechial hæmorrhages are seen close to the vessel. (Zeiss 16 mm. obj. Comp. ocular No. 4.)

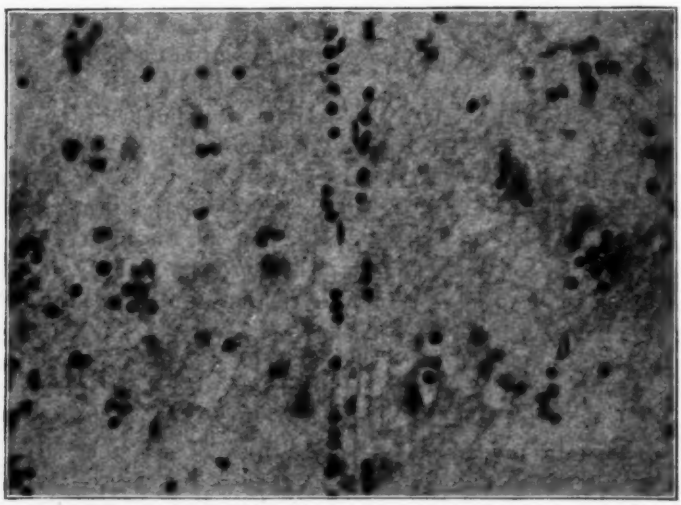

FIG. 8.—Case 20. Cortex. A capillary vessel is seen in the centre of the field, showing short chains of small round cells along its walls. Note the neurophagy of the small nerve cells in the neighbourhood. (Zeiss 8 mm. obj. Comp. ocular No. 4.)

FIG. 9.—Case 20. Field showing an area of hæmorrhage into the arachnoid. (Zeiss 16 mm. obj. Comp. ocular No. 4.)

FIG. 10.—Case 20. View of cortex and meninges to show the patchy infiltration of the meninges with small cells. (Zeiss 16 mm. obj. Comp. ocular No. 4.)

nuclear. Among the red corpuscles there is also a fair proportion of polymorphonuclear leucocytes. It is to be noted that only a small minority of vessels show thrombosis, but all show great dilatation.

Cortex.—There is comparatively little abnormality in the superficial layers of the cortex. The nerve cells show an excess of pigment and all degrees of chromatolysis.

In the deeper layers of the cortex there is everywhere considerable vascular congestion, and in places there are small perivascular hæmorrhages. In a few places close to the smaller vessels there are small collections of serum, as though a leak had occurred in the vessel wall,

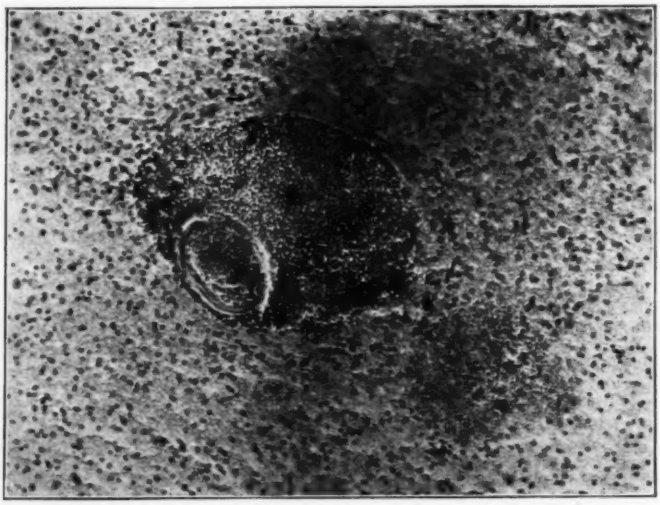

FIG. 11.—Case 20. Hæmorrhage into the perivascular space in a small cortical artery. Note the concentric lines of glial fibres due to distension by hæmorrhage. (Zeiss 16 mm. obj. Comp. ocular No. 4.)

which was too small for the escape of blood corpuscles but had allowed the fluid contents of the blood to exude. In this area there is a great increase of nuclei in the walls of the blood-vessels, and this is to be seen even in the finest capillaries, many of which are outlined by a chain of rounded nuclei. (See fig. 8.)

In the subcortical region, in one or two places, this vascular congestion and perivascular hæmorrhage reaches a maximum, so that most of the tissue is ploughed up with hæmorrhages. In the neighbourhood of such areas it is usually possible to find a fairly large vessel

thrombosed, and it is impossible to avoid the conclusion that the local congestion and hæmorrhage occur at the edge of an area of infarction, and are due to the cutting off of the main blood supply to the part.

Basal ganglia.—In this region the brain substance shows the same changes as in the subcortical layers—viz., vascular congestion, and perivascular hæmorrhages, in some places reaching a maximum and leading to massive hæmorrhage.

Case 21.

The following pathological report concerns the case of a young woman who died in the National Hospital about four months after the

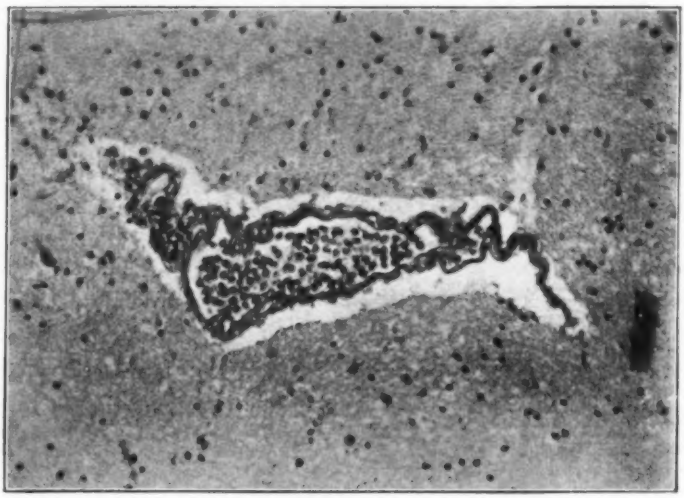

FIG. 12.—Case 21. Blood-vessel in medulla filled with fibrinous clot which is being absorbed by phagocytic mononuclear cells. (Zeiss 16 mm. obj. Comp. ocular No. 4.)

onset of a characteristic and severe attack of encephalitis lethargica which rendered her bedridden until the time of her death.

Pieces were taken from the basal ganglia, cortex, midbrain, pons and medulla.

Meninges.—There is everywhere a small degree of infiltration of the meninges with small round cells. Very few polymorphonuclear cells are seen here, but there is a fair proportion of cells with small pyknotic nucleus and relatively abundant cytoplasm. A small proportion of the vessels show evidence of thrombosis of fairly old standing; in a few

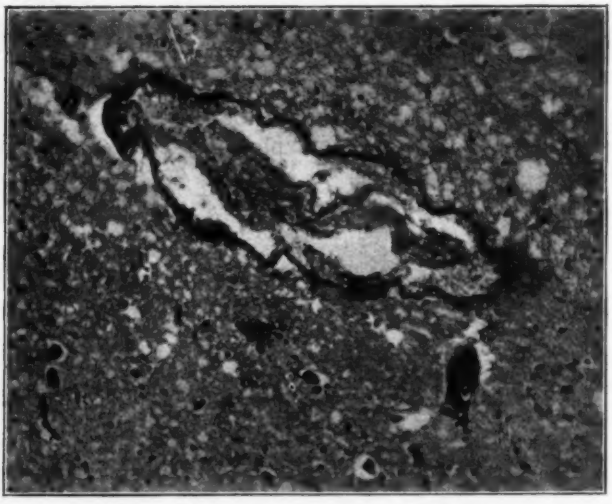

FIG. 13.—Case 21. Basal ganglia. Medium-sized vein showing thrombosis and calcareous degeneration of its walls. (Zeiss 16 mm. obj. Comp. ocular No. 4.)

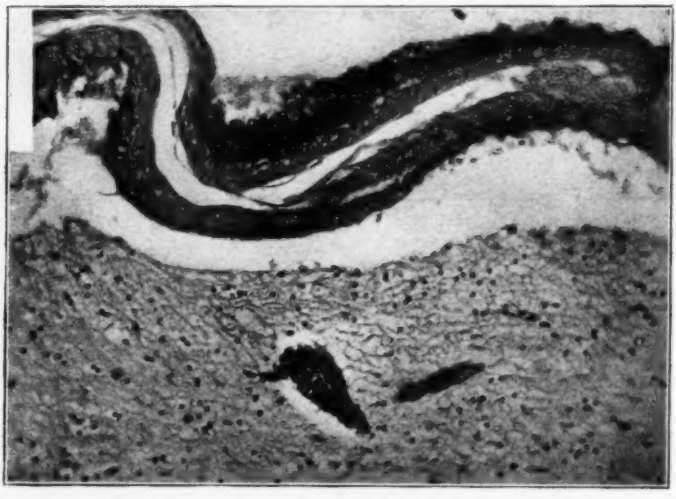

FIG. 14.—Case 21. Lenticular nucleus. A medium-sized artery is seen with extensive calcareous degeneration of its outer coat. (Zeiss 16 mm. obj. Comp. ocular No. 4.)

the fibrin clot is still unabsorbed, and contains large phagocytic cells in its meshes.

Cortex.—The chief change here is in the vessels, a very large proportion of which are thrombosed. Many of the small veins which are thrombosed show no cellular reaction round their walls, but their lumen is filled with fibrin containing a greater or smaller number of large mononuclear phagocytes. The small arteries all show thickening of the fibrous tissue elements in their walls, with more or less infiltration with small round cells in the adventitial lymphatics. Many of them are thrombosed, but the most remarkable change is a calcareous degeneration both of the walls of the vessels and of the thrombus. This is seen more in the larger than in the smaller vessels, and is not nearly so universal in the cortical vessels as in those of the basal ganglia. The vessels which show this change are all thrombosed, and most of them contain an excess of small round cells in the adventitial spaces. (See figs. 13 and 14.)

There is a moderate increase in the number of glial nuclei both in the cortical and subcortical layers, and a few of the capillary vessels show a slight increase in the number of cells in their walls, but this is insignificant compared to the changes in the larger vessels.

The nerve cells of the cortex show slight degrees of chromatolysis, but few show any great degree of degeneration. Most of them show some excess of pigment, but this is not so great as in the cells of the basal ganglia. Only a few of the cells show neuronophagy.

Basal ganglia.—Here the majority of the vessels show thrombosis at some stage of resolution, very many of them having calcareous deposits either in the walls or lumen. There are also some calcareous deposits in the tissues close to large thrombosed vessels. Some of these seem to result from the calcification of thrombosed arterioles, while others are due to deposit of lime salts in areas of perivascular hæmorrhage or effusion of plasma. For the most part it is only the largest thrombosed vessels which show this change. All the vessels show some degree of infiltration of their walls with round cells. The nerve cells are comparatively little affected, only a few of them showing neuronophagy, but all show a considerable excess of pigment. There appears to be a general increase of neuroglial nuclei, and some enlarged neuroglial cells are seen everywhere.

Junction of pons and midbrain.—A great number of the vessels here show thrombosis and there is more infiltration of the adventitial lymphatic sheath with round cells than in the cerebrum. This is

patchy in that it is of greater degree in some vessels than others, but all show at any rate some increase of cells in their walls. One thrombosed artery in the ventral region of the midbrain on either side, near the point of emergence of the oculomotor nerve, shows great increase in the amount of adventitial fibrous tissue and the spaces of this coat are packed with round cells, the majority of which are the size of lymphocytes, the rest being larger, with more cytoplasm and more vesicular nucleus.

The majority of the vessels in the region around the iter of Sylvius are thrombosed and their lumen is full of phagocytic cells of fairly large size. (See fig. 12.)

The nerve cells show only moderate chromatolysis. There is little neuronophagy. There is a slight glial increase, not greater than that seen in the basal ganglia.

Medulla.—Here only a few vessels show any evidence of small-celled infiltration of their walls.

A few of the cells of the nuclei are absolutely normal. Others show some perinuclear chromatolysis and excess of pigment, and a few have eccentric nuclei. Most of the cells of the olivary nucleus are swollen with pigment which displaces the nucleus. This appears to be somewhat in excess of the normal, but these cells very frequently contain much pigment. Otherwise there is very little abnormality.

Case 22.

The following pathological report concerns the brain of a soldier between 20 and 30 years of age, who was admitted into a London military hospital from France with a diagnosis of debility following influenza.

On admission he complained of intense headache and photophobia and was markedly lethargic. The lethargy increased and he became incontinent. Although difficult to rouse he could generally be made to answer questions intelligibly, but he showed some signs of right hemiplegia before he died. Lumbar puncture was performed on three occasions, and the fluid which was drawn off was always found to be normal in regard to its chemical, cytological and bacteriological contents. The blood showed a slight leucocytosis with a relative increase of polymorphonuclear cells.

Cortex.—There is a little meningeal infiltration and a certain amount of proliferation of the endothelium of the walls of the meningeal vessels. The vessels of the cortex are congested, but there is no round-celled

perivascular infiltration. There is, however, evidence of proliferation of cells round the smallest capillaries, showing as rows of three to six small round cells just outside the capillary wall.

The majority of the nerve cells show no abnormality, but a few have lost their Nissl granules more or less completely, and in close contact with these cells there is a number of small round cells. In some cases the body of the nerve cell appears to be replaced by a cluster of such cells. These parasitic cells give with toluidin blue a purer blue staining than the nerve cells, which take on a more purple colour. The chromatic points in their nuclei are arranged around the periphery in the manner seen in plasma cells. But they are for the most part smaller, with rather less cytoplasm than the fully formed plasma cell. The cytoplasm is clear and hyaline, and contains no granules which take up the ordinary stains. Its refractility is fairly high, so that in sections stained with toluidin blue it stands out clearly from the colourless ground substance as a clearly defined white ring.

The ground substance both in the cortical and subcortical layers contains far more nuclei than normal, the majority of which belong to cells of the type just described, leaving a minority of typical glial cells.

In the *precentral convolution* the majority of the Betz cells show little abnormality, but there is here the same excess of small round cells as elsewhere.

Midbrain (below level of nucleus ruber).—The meninges here show only a slight degree of proliferation of endothelial cells, and infiltration with small round cells. No thrombosis of vessels is seen. The majority of the medium-sized vessels and small vessels in the midbrain show perivascular infiltration of greater or less degree. In some of the smaller vessels this forms a cuff as thick as the lumen of the vessel, but this is exceptional. In most cases only one or two layers of small round cells are seen in the adventitial lymph spaces. The multiplication of cells along the walls of the capillaries is well seen here. Most of the cells of the oculomotor nucleus are fairly healthy, but a few show loss of Nissl granules and neuronophagy. The same may be said for the cells of the substantia nigra. The affected cells in both nuclei are scattered irregularly among perfectly healthy cells. There is, however, here as elsewhere, a general increase in the number of glial and mesoblastic cells in the ground substance.

Junction of pons and midbrain.—Here several of the larger veins in the ventral part of the section show recent thrombosis, with collections

of polymorphonuclear and a few mononuclear cells in the fibrin. In the dorsal part, under the upper end of the fourth ventricle, the majority of the vessels show a considerable degree of perivascular infiltration.

The nerve cells of the fourth nucleus show similar changes to those in the higher oculomotor nuclei, the ratio of degenerated cells to normal cells being a small one. Most of them show, however, an increase in the amount of pigment. The cells of the motor nucleus of the fifth are apparently healthy, as are those of the seventh. Similar but less pronounced changes are seen on passing down the pons. There is some recent thrombosis of some of the smaller meningeal veins over the ventral surface of the pons.

Medulla (level of the olivary body).—There is considerable patchy infiltration of small round cells in the antero-median fissure. The cells of the twelfth nucleus are normal, but there is very general infiltration of cells in the tissues under the floor of the fourth ventricle, and several of the larger vessels in this region are ringed with round cells. In the region of the olive this infiltration appears to be less, and there is only a slight excess of glial cells among the cells of the olivary nuclei.

In the nucleus gracilis and cuneatus the cells appear healthy enough, but there is more general infiltration than normal.

Lower part of medulla.—Level of decussation of pyramids. Even down to the lowest level of the pyramidal decussation a few small vessels show small-celled cuffing of their walls, and there is a slight degree of meningeal infiltration. These changes become progressively less on passing from the upper to the lower end of the decussation. In this region no alteration in the nerve cells can be found.

Discussion of the Histological Findings.

In discussing the histological changes found in "encephalitis lethargica" we take the liberty of drawing certain observations from cases, not included in this series, which have found their way into the laboratory of the National Hospital from a variety of sources. In particular may be mentioned a case of Dr. Deas, which was examined for Dr. Grainger Stewart, through whose courtesy we are able to refer to it. This case provided the slightest changes which we have encountered in this disease.

It will have been seen from the detailed account given above, that the histological appearances of the brains examined were very various.

Some of these are accounted for to a large extent by the varying intervals between the onset of symptoms and the fatal termination. Others were present in cases which relapsed several weeks after the beginning of the illness, and may be accounted for by this. Others may be due, to some extent at least, to the age of the patient.

But there are certain features common to all cases in the early stages, which may be briefly summarized. They are:—

(1) Vascular congestion.

(2) Evidence of toxic degeneration of the nerve cells and neuronophagy.

(3) Proliferation of the mesoblastic cells of the vessel walls, and infiltration of the nervous tissue with these cells.

(4) Small-celled infiltration of the Virchow-Robin space.

(5) Glial proliferation.

These are given in the order in which they occur most constantly and most generally in the cases we have examined.

(1) Vascular congestion has been the most striking feature of all the cases examined within the first few weeks of the onset of symptoms. It affects all the vessels down to the smallest capillaries.

(2) The changes in the nerve cells are extremely constant, but they are by no means universal. Some of the nuclei of the brain stem may show very little change when others close to them have many cells affected. In general only a few of the nerve cells of a nucleus or area are affected, but all may show some degree of alteration. These changes, which have been well described by Marinesco, are perinuclear chromatolysis, eccentricity of the nucleus, excess of pigment, and, perhaps most constant of all, neuronophagy.

(3) It seemed clear that the cells taking part in this neuronophagy were, for the most part, derived from the mesoblastic elements, many being closely allied to plasma cells. They resembled in every respect the rows of round cells which could be seen in the same field lying along the outside of the capillary walls (fig. 8). Their cytoplasm is free from granules, and its outer border is rounded and clearly defined, and they occur at a stage of the disease when there is little evidence of glial proliferation. They were seen in large numbers among the nerve cells of the most affected nuclei, and to a less extent throughout all the nervous tissue. In some parts of the cortex, and in a few of the nuclei of the brain stem, almost every nerve cell had several such cells in close relation to it.

In one or two of the cases which showed the greatest changes there

are small collections of such cells in some parts of the pons and midbrain. But dense clusters of cells such as those which invade the anterior horns of the cord in cases of poliomyelitis were never seen.

(4) Round-celled perivascular infiltration was present to a greater or less degree in all the cases examined within the first month or two of the onset of symptoms. But in two cases it was so inconspicuous a feature that a careful search was necessary to find any vessel which showed this change. It is not nearly so universal as is the infiltration of the tissues with plasma cells and lymphocytes, and is always patchy; either it picks out only a few vessels, or when the majority are affected they show great variety in the thickness of the cuff of cells with which they are surrounded. These cells may obviously either be leaving the blood-vessel or returning to it. Several observations tend to support the theory that the majority of these cells are on their way back to the vessel.

(*a*) It is well known that in degenerative diseases of the nervous system the Virchow-Robin space around the veins becomes distended with scavenger cells laden with the products of myelin destruction. It is therefore reasonable to suppose that the current, if any, in this space will be from the tissues to the vein.

(*b*) It is so common as to be almost constant in the cases examined to find collections of small round cells in the meninges in the neighbourhood of the larger veins. As the Virchow-Robin space opens into the pial lymphatics in close relation to the emerging vein, and these again communicate with the subarachnoid space in the vicinity, it is reasonable to suppose that these collections of cells may represent the effluent from the tightly packed perivascular sheaths seen in the neighbouring nervous tissue.

(*c*) Especially in the earlier cases of the disease, it is common to find a very considerable degree of general infiltration of the nerve tissues, and neuronophagy of the nerve cells in an area of the brain where no perivascular infiltration can be found, or where it occurs to only a minimal extent.

(5) In most of the cases there was some evidence of glial proliferation, but this formed a conspicuous feature in only one case (Case 17). This patient died at the end of the sixth week of the disease and showed the typical changes of the disease in an extreme degree. In the subcortical layers there was a great proliferation of neuroglial cells, showing themselves as large irregular cells, with long fleshy processes, and one or more oval nuclei lying near the margin of the cell.

If the only evidence we accept of the early stages of neuroglial proliferation is the presence of glial cells with more than one nucleus, and still more if we regard these large *amœboid* forms as necessary to glial multiplication, we must conclude that this change, although obvious enough in some cases, is not a conspicuous feature of the majority.

Venous Thrombosis and Hæmorrhage.

Although neither of these phenomena are constant in the disease in the cases we have examined, both are sufficiently common in our cases as well as in those described by others to deserve mention. Venous thrombosis appears to be rather more constant than hæmorrhage. Either the largest veins on the cortex or the smallest venules in the substance of the brain or brain stem may be affected, and we have seen such thrombi in all stages of resolution. In the cases which died within a few weeks of the onset of the disease thrombosis was evidenced by a fibrin reticulum occupying a part or the whole of the lumen of the vessel. This usually contained a large number of polymorphonuclear leucocytes and lymphocytes in its meshes, which may be taken as evidence that the clotting had occurred several hours at least before death. The presence of a fibrin reticulum which did not contain leucocytes was not considered to indicate necessarily pre-mortem thrombosis. In the case which showed the most extensive changes (Case 20) a few vessels were seen which showed such a fibrinous coagulum as well as perivascular infiltration and hæmorrhage into the surrounding tissues.

Hæmorrhage seemed to be due definitely to two distinct causes. The commoner form is that where a smaller or larger ring of hæmorrhage surrounds a congested vessel. Such hæmorrhages take place, at any rate in the first instance, into the so-called perivascular space of His, tearing the glial fibres away from the vessel walls and stretching them in a tangential manner (see fig. 11). In some cases, whether from the greater pressure at which the hæmorrhage has occurred or the greater fragility of the glial tissue, the hæmorrhage breaks through this ring, and spreads into the tissues for some distance from the vessel. This form of hæmorrhage usually occurs round veins. It is patchy and irregular, affecting only one or two out of many vessels in a section. It is most often seen in the cortex and in the grey matter under the floor of the fourth ventricle.

Infarction.—The other form of hæmorrhage is that due to infarction. Here there is usually a central focus in which the nervous tissue is

ploughed up with multiple hæmorrhages, and is completely necrosed, and at the edge of this area there are seen numerous petechial hæmorrhages lying in the tissues at a greater or smaller distance from the vessel from which they seem to arise. In some cases the thrombosed artery which gave rise to the infarction can be seen in the section, but its presence can always be inferred from the characteristic changes. The hæmorrhages in this case seem to take place from small arterioles, and evidently occur at much greater pressure than in the previous form. They are of the nature of sudden spurts of blood into the tissues, on one or other side of a vessel, rather than the slow oozing of blood into the perivascular space of His which occurs in the other forms.

Such areas of infarction occurred in Cases 18 and 20 and the onset of this event seemed to be the direct cause of the rapid aggravation of symptoms to which they succumbed.

LOCAL PARALYSIS FOLLOWING SUPERFICIAL INJURIES NOT INVOLVING NERVE TRUNKS: WITH SPECIAL REFERENCE TO TRAUMATIC "ASCENDING NEURITIS" AND TO "REFLEX PARALYSIS."

BY F. M. R. WALSHE, M.D., M.R.C.P.

Assistant in Neurology, Medical Unit, University College Hospital, London.

INTRODUCTION.

AMONG the many difficult problems confronting the neurologist we must include a small group of cases of local paralysis after injury to a limb, in which no nerve trunk has been involved. These cases present the features of an organic peripheral nerve lesion, and commonly follow a trivial superficial injury to the distal extremity of a limb. Four cases of this type are reported in the present paper. In seeking for an explanation of these, two possible causes suggest themselves: they are "reflex paralysis" and traumatic "ascending neuritis."

The conception of *reflex paralysis*, once so popular and emphasized so strongly by Charcot and Brown-Séquard, has now been almost abandoned. It was formerly invoked to explain clinical phenomena having little in common; from a local palsy, peripheral in type, to a complete paraplegia. Irritation of sensory nerve endings in skin or viscera was thought to be the cause of the condition.

There is possibly one instance in which this explanation is still widely accepted—namely, to account for the rapid local muscular atrophy found in acute arthritis and in certain injuries of joints and epiphyses.

The onset of this is rapid. Muscles proximal to an affected joint waste. The wasting is not associated with any degree of tenderness, and until it reaches a profound degree the corresponding tendon-jerk may be normal or increased. Such loss of power as is present is entirely due to wasting, and some observers have stated that section of the afferent nerves of the joint will prevent this. There is therefore some justification for regarding it as reflex in origin, though this solitary fact is all that is known of its pathology.

The cases to be described here do not accord entirely with this clinical picture. They correspond in every instance to the result of a

peripheral nerve palsy, in which there may be motor, sensory, reflex and vasomotor changes. Cases comparable with them have been recorded by Oppenheim [14] and by Kramer [9]. Thus Oppenheim's case was one of gunshot wound of the arm with fracture of the humerus. The wound healed readily, but when the patient came under observation three months later, there was a complete atrophic palsy of the deltoid, biceps, coracobrachialis and supinator longus; while triceps and the forearm muscles were weak. There was neither pain, tenderness, nor sensory loss, and the electrical reactions were normal. Oppenheim regarded the condition as due neither to neuritis, poliomyelitis, nor hysteria, but as a "reflex paralysis" comparable with the arthrogenic atrophies. It differed from these, however, in the presence of paralysis as well as wasting. He suggested that the neurospinal lesion was "dynamic," while the muscular result was "organic."

Kramer's case was almost identical in character and site with the Case 3 recorded in this paper, and he accepts Oppenheim's explanation in respect of it.

During the period of the war, Babinski elaborated a comprehensive symptom-complex of "troubles nerveux d'origine reflexe," for which he seems to have drawn largely upon phenomena hitherto widely regarded as hysterical in nature. Within its limits he has included many gross objective signs of nervous disorder: wasting and loss of power, hypotonus and contracture, exaggeration of tendon-jerks with loss of cutaneous reflexes, altered mechanical and electrical excitability of muscles, trophic and vasomotor disorders, and finally, marked subjective and objective sensory changes. These occur in various combinations and give rise to different clinical forms. According to Babinski, "these phenomena may be entitled *physiopathic*, a term intended to express the idea that, on the one hand, neither hysteria nor any other psychopathic state can produce them, and, on the other, that while indicating a physical and material disorder of the nervous system they do not appear generally to correspond to any nervous lesion that can be detected by the methods at our disposal." Further, "they tend to spread beyond the limits of any anatomical area" [2].

Considerable doubt has been expressed as to whether these symptoms are the manifestations of a true clinical entity, and not rather that of a medley of abnormal conditions, to which hysteria, the mechanical effects of secondary tissue changes and even local tetanus may contribute their share.

Nevertheless, it is possible that cases of the well-defined character of those which form the subject of this paper may have helped to swell the numbers of this apparently ill-defined and heterogeneous collection of clinical forms that Babinski has named "reflex nervous disorders."

The alternative explanation mentioned earlier is that possibly the cases to be discussed belong to that rare nervous affection known as "ascending neuritis." *Ascending neuritis* (neuritis migrans, neuritis ascendans, la névrite ascendante), like reflex paralysis, is an example of a condition once diagnosed freely, but now greatly out of fashion. One of the best early descriptions is that given by Remak in 1861. The case he recorded was in every way typical of those since described. The patient was a man who three months earlier had driven a splinter under the nail of a little finger. The wound healed in two weeks, but a progressive weakness and wasting of muscles supplied by the ulnar nerve followed, while the nerve trunk became tender and thickened. According to Bolten, who quotes the case [3], Remak regarded it as due to infection of the nerve terminations, whence "der Prozess in den Lymphbahnen des Nerven weiter aufwärts verbreitet hätte."

Of recent years numerous similar cases have been reported, though even yet the condition is not universally recognized, and must be regarded as exceedingly rare. The majority have been recorded in the French literature. By English and German writers it has been comparatively seldom referred to, and then mostly in terms of scepticism. Thus, Strümpell [16] does not believe that ascending inflammatory changes in a nerve take place, while Oppenheim [12] says that "as regards simple non-suppurative inflammation this mode of spread has not been sufficiently proved, although isolated clinical observations make it probable that neuritis may penetrate in the central direction from the site of its origin." Krehl, K. Mendel [12] and G. Bolten [3] have described and collected small series of cases of this nature, in Germany, but without any pathological confirmation. In France, Raymond and Guillain [16], Sicard [17], Aynaud [1], Leenhardt and Norero [10], Lejonne and Chartier [11], Brissaud and Gougerot [4], and finally Dejerine and Thomas [5 and 6] recorded cases during the ten years preceding the war, while since 1914 others have been observed by Guillain and Barré [8], and by Ferry [7]. Only the case of Dejerine and Thomas was confirmed by autopsy, and upon this examination rests all that we know of the pathology of the condition.

Sicard [17] has written the most comprehensive recent study of

"ascending neuritis." He regards it as exceedingly rare, and defines it as a localized, slowly progressive lesion, ascending from the distal terminations of the nerve towards its central end. It is constantly associated with an infection of a cutaneous lesion in which nerve endings are infected, and the local reaction may be slight or severe. The nerve affected is that supplying the injured region. He describes three stages: that of a local peripheral reaction characterized by paroxysms of intense pain radiating proximally from the site of injury. This pain may become constantly present in all segments of the limb: it is aggravated by active or passive movements, and rapidly renders the limb useless, indeed it is described as being so severe as to render the patient's existence burdensome. Simultaneously, the pulp of the affected digit atrophies (for the lesion is almost always on a finger), the finger becomes tapering, and covered by glossy, atrophic and cyanosed skin, while the digital joints become ankylosed. Motor loss varies from a just perceptible local wasting to marked atrophy of small hand muscles with loss of power. Objective sensory changes are exceptional. Ultimately the trophic changes may involve the whole hand. Recovery is slow and partial and usually the condition tends slowly to progress.

Rarely, a second stage, that of "réaction à distance," occurs, due to involvement of the posterior root ganglia; pain now spreads, and spasm and tremor may appear. Sicard considers that a third stage of root and cord involvement is possible, but problematical. He does not believe that a sclerotic inflammatory process reaches the posterior root ganglia.

The lesion found in Dejerine and Thomas's case: one of ascending neuritis following a pinprick of the thumb, was a selective degeneration of afferent fibres in the median nerve. The fibres affected were those arising in the digital branches of the thumb and of the radial side of the index. The degenerating fibres could be traced into the sixth and seventh cervical posterior roots, and the cells of the corresponding ganglia showed changes. The roots themselves were markedly atrophied. The nerve showed no signs of old inflammatory interstitial reaction. It was not possible to trace the process into the cord as the patient had tabes dorsalis ("tabes fruste"). This observation scarcely bears out Sicard's views, and it must be admitted that the clinical conception of "ascending neuritis" rests upon a very doubtful pathological basis. Guillain [6] has classed the condition with tetanus and rabies, but Sicard rightly points out that these cannot be regarded as neuritic processes, but as examples of a specific conductivity of toxins and organisms along the nerves, unaccompanied by morbid change in

the nervous elements. Recent research has fully confirmed the earlier observations on the passage of toxins and organisms along the perineural lymph channels, and Orr and Rows [15] have shown that commonly the conducting nerve shows no true neuritis; the nervous lesion first appearing in the posterior root entry zone when the sheath of Schwann has been shed by the entering fibre. Clinically also, there are no prominent symptoms of any affection of the conducting nerve, though there may be, as in the case of tetanus and probably that of diphtheria, symptoms referable to that segment of the central nervous system to which the conducting nerve is attached.

While, therefore, the pathological basis of the clinical syndrome of *la névrite ascendante* is doubtful, there is clinical evidence that probably it is not an example of the "lymphogenous toxi-infective" process described by Orr and Rows. In fact, obscurity pervades the whole subject on both clinical and pathological sides.

Clinical.

Certain cases which came under my observation during the course of military service correspond in their apparent cause and, in some respects, in their clinical picture to the syndrome of "ascending neuritis." As I have stated, it is probable that cases of this type may have helped to swell the ranks of Babinski's "reflex nervous disorders," though to a small extent. Therefore, an examination of them from the points of view discussed here may help to lend precision to our clinical notions of these conditions.

Case 1.—*Small suppurating wound of dorsum of foot followed by paralysis of all muscles supplied by external popliteal division of sciatic nerve, and corresponding sensory loss.*

Private J. was lightly wounded by a fragment of shrapnel on the dorsum of the left foot at the base of the fourth and fifth toes, in April, 1916. He walked unassisted to a dressing station one and a half miles away. Moderate local swelling developed, but the wound healed in two weeks. On beginning to walk more freely the scar broke down and for some days discharged freely. As soon as the second healing was complete and he began again to walk he found that the toes of this foot dragged and caught the ground as he walked uphill. This disability increased, so that now, three months later, he is unable to move foot or toes. He is conscious of an area of skin on the dorsum of the foot which "feels numb and asleep," but beyond an aching in the muscles after exertion he has at no time had any pain. In all other respects he is in normal health.

On examination (July 10, 1916): There is a small scar between fourth and fifth toes on the dorsum of the left foot. There is complete paralysis with marked wasting of the antero-external group of muscles of the leg. Foot-drop is complete and the foot hangs inverted. There is slight general wasting of the whole limb, but the localized wasting noted is distinct from this. The affected muscles are slightly tender to pressure; other muscles show no tenderness. The nerve as it turns round the fibula is tender to pressure, but is not thickened. On the dorsum of the foot and extending over the outer four toes is an area of subjective numbness and of slight objective blunting of sensibility to touch and pinprick. Deep sensibility is normal in the foot and digits. The ankle-jerk is brisk, and the other limb reflexes are all normal. No trophic or vasomotor changes are present.

No electrical examination of the muscles was possible at the time.

In this case a superficial wound within the cutaneous territory of the external popliteal division of the sciatic nerve produced a complete paralysis with wasting of a group of muscles supplied by that nerve. Muscles innervated by the internal popliteal division were unaffected and the ankle-jerk was normal. There appears nothing noteworthy about the injury, apart from the fact that it was the seat of a definite septic process.

Case 2.—Superficial wound of lower third of thigh followed by paresis and wasting of quadriceps extensor femoris and diminution of knee-jerk.

Private McD. was wounded in the left thigh in April, 1916. The wound healed in three weeks without untoward occurrence. About two weeks after return to duty he noticed pain down the front of the thigh on exertion, and a tendency of the knee to give way. This disability increased, so that he was evacuated overseas. On examination (July 24, 1916, that is, three and a half months later), two small healed wounds are seen on the anterior and antero-lateral aspects of the thigh, two and a half inches above the patella. No deep thickening can be felt along the superficial course of the track between these wounds, but this can be felt as a thinning of the subcutaneous fat. X-ray reveals no signs of deep bony injury. There is marked weakness, wasting and tenderness on pressure of the vasti and rectus femoris. The knee-jerk is very feeble, its fellow being brisk. Adductors, posterior thigh muscles and muscles below the knee are normal. The ankle-jerk is brisk. There are no sensory changes.

In this case a superficial wound, involving only skin and subcutaneous tissues, within the territory of the anterior crural nerve has resulted in an atrophic paresis of muscles supplied by this nerve, with gross diminution of the corresponding jerk.

Case 3.—Penetrating wound of the leg in its distal third. Drop-foot, and diminished faradic excitability of all muscles below the knee. No sensory loss. Diminished ankle-jerk. Cyanosis, coldness, and lesions resembling chilblains on foot.

Private B. received a bullet wound running antero-posteriorly through his left leg from behind forwards, between tibia and fibula at junction of middle and lower thirds. He has been unable to move toes or foot freely since. Beyond aching on exertion he has had no pain in the leg, nor any paræsthesiæ in the foot. When cold the foot becomes blue and "irritating spots" come out on the sole and inner part of the foot. During the five months that have elapsed since his wound there has been some wasting of the leg. Examination five months after injury: There are small entry and exit wounds as described. Under the larger anterior scar there is a small muscular hernia when the foot is passively dorsiflexed, otherwise there is no sign of gross injury to muscle, tendon or blood-vessels. The foot hangs dropped and inverted. It is cyanosed and along its inner border and round the heel are numerous small red raised areas resembling chilblains. The calf at its thickest part shows a wasting of one and a quarter inches. This loss of substance is general and not localized to any particular muscle group below the knee. There is some contracture in the calf, and the foot cannot be dorsiflexed passively to less than an angle of 100° with the leg. There is very feeble voluntary power of dorsiflexion of foot and toes within these limits. Plantar-flexion is of fair power, but not normal. The peronei are also very feeble. There is no mechanical excitability of the affected muscles, but slight tenderness on pressure and a slight but definite diminution of faradic excitability of all muscles. The ankle-jerk is very sluggish, its fellow being brisk. The plantar reflex is feeble. Both knee-jerks are brisk. Above the knee there is no abnormality. There is no sensory loss. The patient walks with leg rotated out and steppage gait. Final examination ten months after wound reveals practically no change since first coming under observation five months before.

In this case all muscles below the knee, especially the group supplied by the external popliteal division, show marked paresis with some wasting, although their nerve trunk cannot have been involved by the bullet in its track. There can be no question that the symptoms were either hysterical or simulated.

Case 4.—A blow on the heel, no wound. Severe and progressive atrophic flaccid palsy of all muscles supplied by the sciatic nerve, with corresponding change in reflexes, and sensory loss. Marked cyanosis and coldness of foot.

Private S., on November 6, 1917, as he was lying on his face during an advance, was struck on the iron heel-cap of his left foot by a spent bullet. At once the whole leg "went useless." But there was no severe pain. He was unable to stand and was carried off the field. He could move his toes feebly

during the ensuing week as he lay in bed. Examined ten days after injury, there is no sign of external injury, no bruising or swelling. A skiagram shows "some superficial damage to the outer surface of the external malleolus, a small thin flake being detached—the attachment of the external lateral ligament." The left lower limb already shows a slight general wasting, amounting to a difference of one inch in the circumference of thigh and calf. As he lies in bed there are no vasomotor changes and no œdema. All muscles below the knee show complete loss of power and of faradic excitability. They are extremely tender to pressure, but show no increased mechanical excitability nor any fibrillation. The hamstrings are of normal power, but somewhat tender to pressure. Quadriceps extensor femoris and the adductors are normal in power and faradic excitability and are not tender. The ankle-jerk is absent the knee-jerk normal. There is no plantar response. There is constant pain referred to the inner half of the sole and in the arch of the foot, radiating thence into the calf when most severe. Objectively, there is sensory loss over the whole foot up to the level of the malleoli and over the lateral aspect of the leg, corresponding exactly with the cutaneous distribution of the sciatic nerve. Cotton-wool touch is markedly impaired over this area, and also sensibility to pain and temperature. There is diminution of vibration sense over foot and tibia and loss of position sense in the toes.

When allowed to hang down, the foot becomes blue and cold. The nerve trunk as it turns round the fibula is exquisitely tender to pressure but not thickened. The sciatic trunk is not tender.

On the twenty-second day of the illness, the hamstring muscles are tender to pressure, weaker than their fellows and show slight definite wasting. The hamstring jerk, normal on admission, is now appreciably diminished. The sciatic trunk up to the buttock is becoming very tender, and flexion of the extended leg on the hip is painful. Below the knee wasting increases and pain is almost constant, rendering the patient restless and sleepless. The calf is so tender that the weight of the limb is distressing when he lies on his back. The knee-jerk remains brisk, the knee extensors active and normal in every respect.

On the sixtieth day: The process is extending and increasing in severity, but is still confined to the sciatic nerve. The hamstring-jerk is just obtainable, and its muscle wasting rapidly. The muscles below the knee are showing progressive atrophy. Sensory changes are as before. Mechanical excitability of muscles shows no abnormality. The knee extensors and the knee-jerk remain normal.

Seen for the last time on the eighty-second day, the hamstring-jerk is absent, and no improvement of any kind is to be seen.

The case is noteworthy in that the septic factor can be excluded, and that no direct injury of the nerve endings occurred. The severe progressive paralysis resembled clinically a sciatic neuritis, spreading up the nerve.

Clinical Summary.

We find that (1) a trivial injury, not necessarily a wound and not involving a nerve trunk, may produce marked paresis, or paralysis, with wasting of muscles and diminution of their faradic excitability, impairment of the corresponding tendon-jerk, subjective and objective sensory changes and vasomotor disturbances.

(2) These signs have a definite anatomical topography and correspond to the innervation of a peripheral nerve.

(3) The character of the symptoms is that of a localized neuritis (mono-neuritis). Though in every instance progressive, there is evidence of continued upward extension in only one (Case 4).

(4) In every instance the injury was within the territory innervated by the affected nerve, though not involving its trunk. In two cases (Cases 1 and 2) the cutaneous endings of the nerve had been directly injured. In one (Case 4) it overlaid these, while in one (Case 3) it involved both deep and cutaneous afferent endings.

(5) Sepsis—if we admit Case 4 to the group—does not appear to have been an essential factor.

It is clear that in these cases we are not dealing with a random paralysis, but with an organic disturbance of structures anatomically related. They approximate in type to the conditions known as "ascending neuritis," rather than to the muscular reflex affection of acute arthritis and allied lesions. It is probable that a small proportion of Babinski's cases of "reflex nervous disorders" may have been of the same nature.

In the absence of any sound pathology of these clinical conditions, it is not possible to dogmatize as to the lesion underlying the cases reported here. They indicate, however, that in rare instances the clinical manifestations of a local neuritis may follow trivial injuries, commonly associated with organismal infection, of the afferent terminations of the nerve affected.

REFERENCES.

[1] Aynaud. "Un cas de névrite ascendante," *Rev. Neurol.*, 1907, t. xii, p. 628.
[2] Babinski and Froment. "Hysteria or Pithiatism," London University Press, 1918.
[3] Bolten. "Ueber Neuritis Ascendans," *Berlin. klin. Wochenschr.*, 1908, Bd. xxxix, S. 1758.
[4] Brissaud et Gougerot. "Névrite localisée avec troubles trophiques à la suite de coupure de pouce; névralgie ascendante," *Rev. Neurol.*, 1908, t. xiii, p. 645.
[5] Dejerine. "Sémiologie des affections du système nerveux," 1914, Paris, p. 373.
[6] Dejerine et André-Thomas. "Contribution à l'étude anatomo-pathologique de la névrite ascendante" (with Discussion), *Rev. Neurol.*, 1909, t. viii, p. 496.
[7] Ferry. "Un cas de névrite ascendante," *Rev. Neurol.*, 1917, t. vi, p. 413.

[8] GUILLAIN et BARRÉ. "Forme clinique spéciale de la névrite ascendante," *Rev. Neurol.*, 1916, t. iv-v, p. 666.
[9] KRAMER. "6 Fälle von partieller Nervenläsionen bei Schutzverletzungen," *Neurol. Centralb.*, 1915, xii, S. 446.
[10] LEENHARDT et NORERO. "Sur un cas de névrite traumatique sans plaie à symptomatologie de névrite ascendante," *Rev. Neurol.*, 1906, t. vi, p. 283.
[11] LEJONNE et CHARTIER. "Névrite ascendante et rheumatisme chronique," *Rev. Neurol.*, 1906, t. xix, p. 873.
[12] MENDEL, K. "Neuritis und Unfall," *Monatschr. f. Psychiat. u. Neurol.*, 1908, Bd. xxiii, S. 364.
[13] OPPENHEIM. "Textbook of Nervous Diseases" (Bruce's translation), 1911, vol. i, p. 419.
[14] *Idem.* "Über einen Fall echter Reflexlähmung (?)," *Neurol. Centralb.* 1915, ii, S. 51.
[15] ORR and ROWS. "Lymphogenous Infection of the Central Nervous System," *Brain*, 1914, vol. xxxvi, p. 271.
[16] RAYMOND et GUILLAIN. "Névrite ascendante consécutive à une plaie de la paume de la main" (with Discussion), *Rev. Neurol.*, 1905, t. iv, p. 248.
[17] SICARD. "Le syndrome de la névrite ascendante," *Rev. Neurol.*, 1905, t. xvi, p. 838.
[18] STRÜMPELL. "Spez. Path. u. Therap. der inneren Krankheiten," Leipzic, 1907, Bd. ii, S. 385.

Section of Neurology of the Royal Society of Medicine.

President—Dr. W. Aldren Turner, C.B.

DEMONSTRATION OF CASES ILLUSTRATING THE LATE EFFECTS OF INJURIES OF THE NERVOUS SYSTEM[1]

Shell Wound of Head, Right Temporal Region, Sensory Paresis of Left Hand and Foot; Mental and Physical Symptoms due to Hole in Skull; Effect of Closure with Osteoplastic Graft.

By Henry Head, M.D., F.R.S.

(1) Captain E. C. T. E., R.A.M.C., aged 29; wounded March 22, 1918, with the fragment of an aëroplane bomb. He did not realize he was hit, but continued to dress the wounded. Was wearing nothing on his head at the time. Then remembers nothing until he found himself in Rouen. He was admitted to the casualty clearing station with a "small penetrating wound through outer and inner tables of the skull and a small piece of the inner table had been driven into the brain. There was a large extra- and intra-dural hæmorrhage." He arrived at Rouen on March 26, and the wound was explored two days later. A subdural hæmorrhage was found and the wound was drained. He made an uninterrupted recovery.

Admitted to the London Hospital on April 13, 1918, with paresis of left arm, leg and face. The wound had healed except for some granulating tissue over the centre of the pulsating portion. It was situated in the right temporal region 15 cm. to 19 cm. behind the nasion and 7 cm. to 10 cm. to the right of the middle line; total nasion-

[1] At a meeting of the Section, held December 11, 1919.

inion line, 35 cm. At this time he suffered greatly from headache. The lower portion of the left half of the face was weak and the tongue was protruded somewhat to the left. All the deep reflexes on the left side were brisker than those on the right, but there was no ankle clonus and the plantar gave a downward response; the abdominal reflex was absent on the left side. Grasp of the left hand was weak and isolated movements of the fingers were poorly performed. The lower extremity was not affected. The greatest change was in the sensations from the left hand and foot. Recognition of passive movement was diminished in the whole of the left hand and great toe, but not in elbow, shoulder or ankle. The compasses were badly discriminated over index, middle, ring and little fingers and over the left sole. Localization was poor over the four fingers but good over the sole. The tactile hairs showed loss of sensibility of these fingers and the sole, but there was no definite loss to temperature, and prick was unaffected. There was gross loss of recognition of shape and texture in the left hand.

In May, 1919, he was admitted under my care, at the Empire Hospital, for headache. The wound was deeply depressed, pulsating, and he was perpetually conscious of the opening. Stooping upset him; he could not travel in the train or play golf. Concentration and intellectual effort at once brought on a headache. The physical condition was almost exactly as before.

On May 28, 1919, Mr. Wilfred Trotter filled in the hole in the skull with a piece of bone taken from the right shin. The wound healed by first intention.

The skull now felt completely normal on palpation, and it would have been difficult to say where it had been repaired. All signs of pulsation had disappeared, and the scar was absolutely painless. He was no longer troubled with the feeling of an opening in the skull, but could stoop and make unexpected movements without any abnormal sensation. His power of intellectual effort increased, and he was again able to play golf.

[This patient was unavoidably prevented from attending the meeting, and was replaced by the following officer.]

(2) Captain E. N. C., Indian Army, on February 19, 1918, was serving in Mesopotamia; his saddle slipped, and he fell under his horse. He was kicked in the left parieto-occipital region, and sustained a compound fracture of the skull. He was operated upon within a few hours. "Bone fragments were removed; the brain below the injury

was pulped to a depth of about 3 in., and hernia cerebri developed, which subsided after three lumbar punctures." He was admitted to the Empire Hospital for Officers on September 6, 1918. The wound had healed completely and was covered with a deeply depressed pulsating scar. He showed definite aphasia and right hemianopia, with loss of central vision on the blind side. There were no other abnormal physical signs. He suffered from no headache, but was much troubled with consciousness of the opening in his skull. He could not stoop or make any sudden movement without the pulsation increasing considerably. He was easily tired, both by travelling in the train and intellectual effort. Physical exertion, such as walking, did not produce abnormal fatigue.

On October 17, 1919, Mr. Wilfred Trotter filled in the hole in the skull with three grafts from the tibia. The opening measured 11 cm. in length, and 5½ cm. vertically. The wound healed by first intention, and when the patient was shown at the meeting it was impossible to make out with certainty where the opening had been.

The most striking change was the patient's recovery of confidence in himself; he no longer feared to stoop, or to make sudden movements, and lost the habit he had acquired of placing his hand over the opening when he sneezed or coughed. Associated with this recovery of self-confidence, his power of speech distinctly improved.

Closure of Openings in the Skull by Bone Grafts.

By WILFRED TROTTER, M.S.

OPERATION: The opening is exposed by the reflection of a large flap, not including the pericranium. If the scar of the original injury in the scalp is of doubtful vitality it should be excised and the opening in the flap stitched up. The gap in the skull is outlined by an incision down to the bone at its edge. The pericranium is reflected away from the opening. The dura and scar are freed from attachment to the bone, and the scar is pared down as much as is possible without opening the subdural space. No harm will result if the subdural space is accidentally opened. The rounded edge of the bone is cut away with a chisel so as to give a flat surface on which a graft can lie. Thin slices of adequate size to overlap the opening are then cut with a frame saw from the inner surface of the tibia, the periosteum being divided and reflected in such

a way as to leave a fringe projecting all round the graft, but especially at its ends. The graft is laid on the opening and secured firmly in close apposition to the skull by numerous stitches between the fringe of periosteum surrounding the graft and the fringe of pericranium surrounding the hole. In this way absolute fixation can always be secured. Most openings left by war wounds can easily be closed by two grafts, but sometimes more are necessary. It is not difficult to reconstitute the skull—even though flat grafts alone are used—in such a way that after a lapse of some months it is scarcely possible to detect any abnormality in shape.

Indications for operation: It is rare for any patient who has an opening in the skull to be quite free from symptoms. The smaller the opening and the more rigid the scar by which it is occupied the less likely are the symptoms to be pronounced. The commonest symptom is tenderness of the scalp around the gap. When the latter is in a situation to be pressed on by a hat the inconvenience is serious. Consciousness, more or less unpleasant, of movement at the opening is also common. This of course varies with the area and the thinness of the scar. Every movement that causes even a slight variation in the venous pressure is felt at the opening. Thus when the patient stoops, coughs, sneezes, laughs, or makes any effort, he feels the brain bulge and the scar stretch. One patient, who had had an inguinal hernia, compared the feeling in the head when he coughed or laughed with that which the rupture had given him. Sometimes the arterial pulsations of the brain are a source of distress, especially in the recumbent posture. Actual headache comes next in the order of frequency. To be characteristic it should show evidence of a mechanical origin, being brought on either by the depressed or the expanded position of the brain. In the former case, the patient will say that he wakes in the morning without headache, but that this comes on after he has been on his legs some time, and is at its worst at bedtime. In the other case the patient will wake with headache, which improves after he has got up.

In certain cases of traumatic epilepsy there is evidence that the opening aids in maintaining the abnormal excitability of the brain. When the onset of the fits has a definite relation to posture, this possibility should especially be considered. Frequently it is obvious that the opening in the skull is a source of uneasiness and distress that the patient cannot put into definite words. He may complain of being worried by the unnaturalness of his condition, by a supposed danger of injury, or he may be able to do little more than convey a sense of

anxiety, not the less distressing for being indefinable. Whether these are to be regarded as evidences of disturbed function of the brain or of the mind, they are invariably relieved by closure of the opening. Whenever headache is a pronounced symptom and the opening is small and the scar rigid, the possibility that there is an element of unresolved contusion in the case should always be considered. When there is little movement of the scar with changes in posture, the mere opening is unlikely to be a source of the symptoms. When there is any doubt as to the diagnosis, an exploratory operation to determine the condition of the brain should be done.

Shell Wound of Head, 1915; Persistent Headache Four Years; Operation; Free Opening of Skull and Dura in Region of Injury; Contusion of Brain Found; Relief of Headache.

By WILFRED TROTTER, M.S.

J. W., AGED 31. Shell wound of skull, 1915. Patient did not remember anything for several days after. He had two operations for removal of fragments of bone and metal. The wound healed in about ten weeks. As soon as he was allowed out of bed headache began and persisted up to the recent operation four years later.

Character of headache: A dull aching pain was continually present and was liable to severe exacerbations. These were brought on by exertion, fatigue, excitement, or worry. The headache when severe was accompanied by giddiness. On three occasions he "fainted" at his work. He was unable to continue his work as a gardener, as stooping was particularly apt to bring on the pain. The headache was felt over the vertex of the skull round about the scar.

Operation, November 11, 1919: Bone removed in region of the scar and dura incised freely. There was slight bulging of the brain. The arachnoid was opaque and slightly distended by fluid collected under it. The brain was stained an orange colour as the result of extravasation of blood. The conditions were typical of an old unresolved contusion. There has been a great improvement in the headaches since the operation.

This case is shown as characteristic of a common sequel of head injury due to war wounds. The pathological basis of the condition is

an unresolved contusion of the brain substance; of its clinical manifestations, headache is by far the most conspicuous.

In a typical case the history will be that the patient has suffered a local injury to the vault of the head from a bullet or shell fragment. The injury may appear to have been a mere graze or to have involved the bone. It will be characteristic that there has been no great loss of bone substance. If there has been a perforation of the skull the opening will be quite small and usually closed by a rigid scar. The headache generally comes on, or is first seriously complained of, during convalescence, when the patient is beginning to get about. There may be more or less continuous moderate headache, but the chief feature is the liability to attacks of very great severity. Such attacks may last from a few hours to several days, and are apt to be brought on by physical exertion, by exposure to bright lights or loud noises and by mental excitement. In some cases stooping and even a brief physical effort may cause a throb of intense pain and, if often repeated, lead to a definite attack. During the attack the headache is of an intense throbbing, bursting character and often of unbearable severity. In many cases the patients declare that between attacks they feel perfectly well. Giddiness is often complained of and is brought on by the same causes as produce pain. If the injury is appropriately situated there may be signs of slight functional defect of the cortex, but commonly headache is the dominating symptom. When the brain in the region of the scar on the scalp is explored evidences of an old contusion are found. There may be more or less increase of tension, but this is so slight as often scarcely to be distinguishable from the effect of venous engorgement due to the anæsthetic; the arachnoid is opaque and its trabeculæ unduly visible, and it is distended by the local accumulation of fluid beneath it; the brain shows discoloration from old extravasation of blood. In the patient shown, the brain in the contused region was of a deep orange tint though four years had elapsed since the injury. The evidences of contusion vary in intensity, and in well marked cases amount to a definite meningitis serosa circumscripta. Occasionally a small amount of actual blood clot is found on the surface of the brain.

After free removal of bone and incision of the dura the headache is greatly relieved or completely cured. Some months later the opening in the skull should be closed.

On the theoretical aspects of the condition it may be desirable to call attention to two well established matters of principle. First, the

resilience of the skull is such that it may be accepted as an invariable rule that whenever a missile travelling at high velocity touches the bone, the latter is driven in upon the brain with force enough to inflict a considerable bruise. It is quite unimportant whether the bone shows evidence of injury to ordinary clinical or X-ray examination. The bone may have recovered its shape completely and have sustained no fracture and yet have caused a distinct local lesion of the brain. If it can be shown, then, that such a projectile has touched the skull the existence of a local cerebral contusion at the point of contact may be assumed.

Secondly, the brain, being the only organ in the body with a capsule (the skull) completely rigid to all physiological forces, is unable to undergo the compensatory general swelling by which the circulation is maintained through any other bruised organ. Thus it is that a contusion of the brain is apt to remain unresolved much longer than a similar condition anywhere else. In the case shown, there were visible evidences of contusion no less than four years after the injury. This tendency of lesions that elsewhere would be trivial and passing to persist and cause grave symptoms is altogether peculiar to the brain. Like very many other phenomena special to cerebral pathology, it is a direct consequence of encapsulation by the skull.

Gunshot Wound of Head; Fracture of Left Frontal and Parietal Bones.

By Oswald Shields, Major R.A.M.C.

Pensioner A. J. G., aged 21. Wounded on September 1, 1918 (bullet); bullet entered left parietal and passed out through left frontal region.

Operation in France on September 2, 1918: Entrance and exit wounds excised, and fragments of bone removed; extensive laceration of brain found.

Symptoms: Very severe frontal headaches.

Operation on November 22, 1918, by Major Shields: Plate of perforated celluloid placed over opening in skull in order to close gap (at this time the smooth celluloid plate was not being inserted between skull and dura). Headaches were much relieved for eight months, then again became severe.

Operation on October 28, 1919, by Colonel Sargent: Hole in skull

enlarged and celluloid plate removed; dura freed from skull and thin sheet of smooth celluloid placed between skull and dura; perforated celluloid placed over opening in skull, and scalp sutured in place.

Gunshot Wound of Head; Fracture of Left Frontal and Parietal Bones.

By Oswald Shields, Major R.A.M.C.

Pensioner S. H., aged 25. Wounded on April 27, 1915 (shell).

Operation (in France): Decompression; date uncertain.

Symptoms: Severe frontal headache, vertigo and fits, becoming more severe.

Operation on February 28, 1919, by Colonel Sargent: Dura found adherent to brain; fat graft inserted between dura and brain after freeing; double celluloid perforated plate placed over opening in skull; scalp sutured in place.

Operation on March 14, 1919, by Colonel Sargent: Celluloid plate removed and replaced by perforated zinc plate. Suppuration followed.

Operation on March 24, 1919, by Colonel Sargent: Zinc plate removed; fat graft seen to be necrosing in places; August 18, 1919: three fits; another on September 27, 1919.

Operation on November 18, 1919, by Colonel Sargent: Old fat graft found to be completely fibrous and adherent to pia, so that it could not be removed; it was freed from skull around opening; a thin smooth celluloid plate was inserted between skull and fat graft, and a large thick perforated celluloid plate made to the shape of the skull was placed outside skull to cover the opening; scalp sutured in place.

Facial Paralysis.

By E. Farquhar Buzzard, M.D.

Pensioner B., aged 23. Blown up by shell on April 1, 1918; face swelled up and paralysis was noticed two days later; weakness in left arm and leg was present at first, has since improved, but still shows on much exertion; there is now complete facial paralysis

and loss to faradism, except for orbicularis oris. Probably there is a pontine lesion in region of right facial nucleus, orbicularis oris fibres escaping.

Case of Spastic Paraplegia illustrating certain Reflex Phenomena and the Impeding Influence of Muscular Hypertonicity and Reflex Spasms on Voluntary Movements of the Lower Limbs.

By GEORGE RIDDOCH, M.D.

SECOND-LIEUTENANT F. C. J., late L.N. Lancs, was shot by a sniper in the back on July 31, 1917. He sank to the ground at once and was unable to move his legs. Free from pain at first, he suffered later from intense soreness of the inner aspects of the arms from the wrists to the axillæ and of the upper part of the back and chest while being carried to the aid-post on an improvised stretcher.

On admission to the Empire Hospital on August 3, 1917, his condition was found to be as follows: The bullet had entered in the left supraclavicular fossa, crossed the back and made its exit 10 cm. to the right of the second thoracic spine. The pupils were equal and reacted well to light and shade. Reflexes: Arm-jerks were present and equal on the two sides; abdominals absent in all segments; knee- and ankle-jerks not obtained. On scratching either sole with a pin a feeble flexion reflex with up-going toes was evoked. Motion: Complete flaccid paralysis of the lower limbs and trunk below the fourth rib. No involuntary movements of the lower limbs were present. Sensation: On the chest, back and inner aspects of arms and hands in the distribution of the eighth cervical, and first, second and third thoracic posterior roots, a dragged pin gave rise to a disagreeable feeling of soreness. Below the fourth rib, though there was complete loss of sensibility to prick, light touches were appreciated, and better on the right than on the left half of the body. Bladder and rectum: Retention of urine and fæces.

X-ray examination: No displacement nor fracture of bone could be seen.

Operation: Forty-one days after the injury the spines and laminæ of the seventh cervical, and first, second, and third thoracic vertebræ were removed. Unfortunately, a record of the condition of the membranes and cord found at operation does not seem to have been made.

A fortnight after the operation the patient could move the toes of his right foot and slightly bend the right knee. Some weeks later similar movements were possible in the left lower limb. At this time all involuntary movements were flexor in type, and it was not till March, 1918 (eight months after the injury), that strong extensor spasms appeared. About a month later he was able to initiate extensor movements of the legs by voluntary effort. It was now possible to begin stepping exercises. Though voluntary power was slight it was sufficient to change the direction of the reflex movement from extension to flexion or flexion to extension. So the sequence of events was as follows: When placed on his feet, the tension on the calf-muscles excited strong extension of both legs and he was able to stand upright, balancing himself with the help of the self-propelling chair. Then concentrating his attention on one leg he could inhibit the tonic limb extension and evoke a flexor spasm, this in turn being replaced by extension. The process was next repeated in the opposite limb. Because of the spasticity the effort expended was very great and the exercise could be gone on with for a short time only. Gradually, however, he regained more control over the limbs.

His present state, two years and four months after the injury, can be summarized as follows:—

Reflexes: Abdominals.—When the stimulus is applied in the epigastric region a local reflex response is obtained, but when the site of stimulation is near the groin a general contraction of the muscles of one half or of the whole abdominal wall usually results. Cremasteric and bulbo-cavernosus reflexes are present and erection of the penis is of frequent occurrence. Knee- and ankle-jerks are very brisk on both sides, and foot and patellar clonus is well sustained. The twitch of the knee-jerk is often followed by rhythmic extension of the limb at hip and knee due to contractions of the glutei and quadriceps extensor cruris muscles occurring at the rate of about four in five seconds. These movements, which are most often bilateral, move the pelvis forwards and backwards. The hamstring muscles take part in the backward movement. This reaction often follows a bilateral extensor spasm and is evoked by handling the penis or by rubbing the lower part of the abdomen or the inner surface of the thighs. It is inhibited by nocuous stimulation of the sole of the foot or by dorsiflexing the foot suddenly; the former mode of stimulation exciting a flexion reflex and the latter an extensor thrust.

Flexion reflex: Flexion of the lower limb with up-going toes is

obtained by pinching, pricking or scratching the foot or the leg. Evoked by squeezing the upper part of the thigh it appears sometimes to be a primary reaction, but most often it is secondary to a brief downward movement of the toes. The lower limbs are so sensitive to stimulation and the reflex movements evoked are so vigorous that it is difficult to determine the exact nature of the crossed response with the flexion reflex. The obvious movement is flexion, but sometimes initial—very brief—extension is apparent. After a flexor spasm the lower limbs usually extend vigorously at hip, knee, and ankle, all the muscles of the thigh and leg being strongly contracted. The toes, however, are dorsiflexed. An extensor thrust of the limb, in which the toes move down, is obtained by pressing on the sole of the foot so that the tension on the calf muscles is increased. Abduction and eversion of the foot tend to be associated with extension of the limb and adduction and inversion with flexion.

Motion: He can perform all movements of the trunk and lower limbs, but in attempting to flex or extend the legs he has still great difficulty in controlling spasms. He can determine the direction of the movement, voluntary impulses exciting the appropriate motor paths. But once started the movement is carried on largely by reflex action outside his control, and he has great difficulty in regulating its amplitude and vigour. In addition the hypertonic condition of the muscles offers great resistance to voluntary effort. He moves his limbs more freely and in a more controlled fashion after they have been immersed for a time in a hot bath. Independent movements of the foot and toes are possible, but when asked to flex or extend the knee or hip all the flexors or extensors of the limb are brought into action. Involuntary flexor and extensor spasms of violent character are still frequent. Both flexor and extensor muscle-groups are hypertonic, but when the limbs are moved passively the resistance encountered in the extensors is different from that in the flexors. The resistance of the extensors is maximal at the beginning and then suddenly gives way, while that of the flexors is more or less constant throughout, the muscles gradually lengthening. There is very little muscular wasting.

Sensation: The inner aspects of the arms and the upper part of the chest and back are much less tender to touch and pressure. Below the level of the fourth rib light touch is everywhere appreciated, though less clearly than in normal parts. The defect increases towards the feet. Pin-pricks are said to be "sharper" and "more disagreeable" than normal, and cold objects give rise to a sensation with a distinctly

painful quality. The vibrations of a large tuning fork (C_{128}) are not appreciated in the lower limbs and trunk below the sixth rib, and the recognition of changes in posture and of passive movement is gravely disturbed.

Vaso-motor, secretory and trophic changes: Dependence of the limbs does not cause œdema, and the patient never sweats from the trunk and legs. The skin is dry and scaly. There are no bed-sores.

Bladder and rectum: He is able to control to some extent the automatic activities of the bladder and rectum. Micturition can be started off before the bladder is full, and provided the contents of the rectum are soft he can expel them by voluntary effort; he can prevent reflex micturition but for a short time only. He always knows when the bladder is full and when empty.

Case of Meningitis Circumscripta Serosa following a Bullet Wound of the Neck, with Injury of the Posterior Columns of the Spinal Cord.

By George Riddoch, M.D.

The clinical features of this case due to the medullary injury were described in a paper read before the Section on January 24, 1918. It will be sufficient here to summarize them briefly.

Lieutenant B., R.A.F., was struck by a bullet in the back of the neck on August 12, 1917, while flying. Both arms were immediately paralysed, but he could move his trunk and legs fairly well. He suffered from intense pain across the shoulders, which were very tender to touch. Injury to the third cervical laminal arch was noted at the casualty clearing station, and an unsuccessful attempt was made to remove pieces of metal which were lying in the soft tissues of the back of the neck.

On admission to the Empire Hospital on October 20, 1917, the wound had healed, but in the track of the scar there was an oval depression, 6 cm. long and 3 cm. broad, the floor of which appeared to rest on the laminal arch. X-ray examination showed that damage had been done to the spines and transverse processes of the third, fourth, fifth, and sixth cervical vertebræ. The left pupil was larger than the right and there was slight ptosis on the left side. Poorly sustained ankle clonus was obtained and on scratching the sole of

either foot hamstring contraction accompanied downward movement of the hallux. Other reflexes were normal. Except for weakness of both arms, especially of the hands and fingers, and on the right side more than on the left, motor power was very little affected. There was slight wasting of the arms but more of the fingers, and the tone of the muscles was greatly diminished. The movements of the arms, especially of the hands and fingers, were grossly inco-ordinate. His gait was ataxic, and when he stood upright with his eyes closed he swayed from side to side. Tactile sensibility was gravely disturbed in the pre-axial side of the forearm and in the thumb and first three fingers. Over the same area sensibility to prick, heat and cold was defective. Tactile localization and the appreciation of deep pressure and pressure pain were everywhere unaffected except in the hands and forearms. The spacial elements were disturbed in the hands and arms out of all proportion to the other aspects of sensation. He was quite unable to find objects with his hands in the dark or when his eyes were shut, though he knew their position in space quite well. To turn on the bed-lamp in the night he had to grope for the switch with his upper arm and then press it down with his teeth. He was quite unable to dress himself and had to be fed.

Though the sensory condition of the hands has not altered much in the last two years, and the movements of his hands are clumsy, he can now do everything for himself, and drives a motor car with safety even in the dark. He rode on a bicycle for a time but had to give it up as accidents were too frequent. So long as he kept a watch on his hands everything went well, but as soon as his attention was diverted by obstacles on the road his hands left the handle-bars and he found himself in the ditch.

In March, 1919, he was readmitted to hospital and Mr. Trotter obliterated the hole in his neck by a plastic operation. His general health at this time was excellent, but for the last three months he has been gradually becoming less fit. His gait is again unsteady at times and he has greater difficulty in controlling the movements of his arms and hands. The physiological deterioration dates from a bathing accident in August. While swimming under water on his back his head struck a ridge of sand with such force that he turned a somersault: he felt something click in his neck, was giddy and felt nauseated for a few minutes, but was able to get out of the water without help. A few days after the accident he noticed that the depression in the neck had reappeared.

In September he went to bed one night feeling out of sorts, and about four o'clock in the morning woke up sick and giddy. He vomited and felt very faint and dazed. Severe pain radiated from the region of the depression in the neck, over the back of the head, and spasmodically down the spine. He was compelled by the pain to keep his head, neck and shoulders rigid. His mother, who was with him, noticed that the hole had disappeared. The attack, after lasting for about six hours, stopped suddenly and he felt quite well again. Since then he has had five similar attacks, four in bed in the early morning and one while he was lying in his bath.

On examination it was found that the skin corresponding to the distribution of all the cervical and the upper four or five dorsal nerves is very tender to pressure and to a dragged pin. The increased sensitiveness is most pronounced on the back of the head, the posterior part of the vertex, the sides of the head including the ears, the neck and over the shoulders and upper arms and the upper part of the chest and back.

In the attacks, which are precipitated by local circulatory changes connected with the supine posture, not only the cervical cord but also the medulla are implicated. Consequently decompression is a matter of urgency.

Subsequent report: On December 20 Mr. Trotter removed the laminal arches of the second, third, fourth and fifth cervical vertebræ. The exposed dura bulged through the opening and when pricked a stream of clear cerebro-spinal fluid spouted up to a height of 5 or 6 in. On slitting open the dura the arachnoid over the whole uncovered area was seen to be opaque and its strands thickened. The spinal cord, which pulsated fully, appeared to be normal. Having approximated the edges of the dura by two or three widely separated interrupted sutures, the muscles were firmly stitched together in layers and the wound closed. The patient stood the operation well and at the time of writing, seven days later, he is very fit, complains of no discomfort, and the tenderness in the cervical root distribution has gone.

Case of Lesion of the Suprascapular Nerve and First Dorsal Root, with Hemisection of the Cord produced by a Single Missile.

By C. P. Symonds, M.D.

E. R., aged 28, while himself in the act of firing his rifle, was sniped at a distance of thirty yards: he fell back into the trench and at once noticed that his left arm was useless; he then found he could not sit up nor use his legs. On his way down to the clearing station he lost the use of his right arm and at the same time his power of speech, hearing and vision. He had retention of urine for a week, having to be catheterized. At the end of this time he recovered speech, sight and hearing, but remained quadriplegic. At the end of three months he recovered the use of his right arm somewhat suddenly. Power in the right leg returned slowly and it was eight months before he could walk. He continued to improve for another six months, and since then his condition has remained stationary. He now complains of weakness of the left arm and leg, and has noticed in his bath that he is unable to appreciate differences of temperature with the right leg.

On examination, there is the scar of a bullet wound on the outer aspect of the left arm 3 in. above the elbow: no exit wound. He shows slight narrowing of the left palpebral fissure, and the left pupil is constantly smaller than the right. There is complete atrophic palsy of supra- and infra-spinati on the left side; the intrinsic muscles of the left hand are completely wasted, resulting in *main en griffe*, and there is a band of cutaneous anæsthesia corresponding to the segmental distribution of the first dorsal root. Below this level, over the right half of the body and right lower limb there is impaired sensation to pin-prick and heat and cold, and some light touches are missed. The power and reflexes of the right lower limb are normal. The left lower limb shows spasticity in extension with exaggerated tendon reflexes, ankle clonus and extensor plantar response: the abdominal and cremasteric reflexes on this side are absent. Vibration sense is definitely impaired over the left tibia, and there is some loss of sense of position in the left foot.

Stereoscopic X-ray plates show the casing of a rifle bullet lying superficially to the left of the fifth cervical spine; in addition very

numerous small metallic fragments representing the burst core of the bullet; these fragments are all superficial except a tiny one which is apparently within the vertebral canal at the level of the sixth cervical vertebra, the arch of which is fractured. The upper border of the scapula in the neighbourhood of the supra-scapular notch shows evidence of injury. Thus a single missile has divided the supra-scapular nerve, cut the first dorsal root close enough to its origin from the cord to implicate the cervical sympathetic fibres, and finally produced a hemisection of the cord itself.

Case of Spastic Quadriplegia following Injury of the Spinal Cord in the Upper Cervical Region, showing Certain Unusual Reflex Phenomena.

By E. Farquhar Buzzard, M.D., and George Riddoch, M.D.

Sergeant V., aged 35, wounded by a spent bullet in the upper part of the neck on February 7, 1915. Entry wound: Small round scar 1½ in. above and 1 in. behind tip of left mastoid. No exit wound. Patient says the bullet was found in his coat collar. Immediate paralysis and loss of sensation in trunk and all four limbs. For some time after being hit he was unable to speak and his breathing was much embarrassed. He was compelled to take quick short breaths. There was retention of urine at first, but in a few hours the bladder began to empty its contents automatically.

In a little over a week he was able to move his right great toe voluntarily, and three or four weeks later his left great toe. Voluntary power in his lower limbs improved steadily. About two months after he was wounded he could flex and extend the right thumb at the metacarpo-phalangeal joint. Sensibility in the trunk and limbs also began to recover and he regained some control over the bladder and rectum.

Summary of Present State.

He has become, perhaps, too resigned to his disability.

Pupils: Right larger than left. Both are regular, central, and react well to light and on accommodation. Both dilate on shading, but the left sluggishly and with small excursion. Left palpebral fissure is narrower than right. Otherwise cranial nerves are normal.

Motion: He can perform all movements voluntarily. The legs are better than the arms and the right arm and leg better than the left arm and leg. Voluntary effort is handicapped by the muscular hypertonus. Of arm movements, adduction is performed better than abduction at shoulder and he finds it easier to move the arm backwards than to bring it forwards; at the elbow, extension is better than flexion, and pronation of the forearm than supination; at the wrist, extension is a little stronger than flexion. The fingers are used clumsily. On attempting to extend the fingers the hand remains somewhat flexed at the wrist, though less so than when the arm is lying at rest. When he makes a fist the hand is strongly extended at the wrist. He can oppose the thumb to the little finger but, like all other movements, opposition is performed slowly and deliberately. Muscular relaxation, on command, is delayed. On asking him to clench the hand and then to open it quickly, a quite appreciable interval elapses before the command is begun to be carried out and the movements are performed slowly and in a jerky fashion. When the patient flexes or extends either leg against resistance, the arms flex involuntarily at the elbow, extend at the wrist, and the fingers and thumb fan out; being extended at the metacarpo-phalangeal joints and slightly flexed at the interphalangeal joints (claw-hand). He can now walk for a short distance without support, though he has considerable difficulty in keeping his balance on account of the general extensor rigidity. He has to watch his feet carefully.

Posture: As he lies in bed the arms are adducted at the shoulders, almost completely extended at the elbows, slightly flexed at the wrists, the hands not being quite in line with the forearm, which is fully pronated; the fingers are extended, the thumb adducted and opposed to the palmar surface of the index finger, and the fifth finger a little abducted from the fourth. The lower limbs lie on the bed extended at hips and knees and rotated out; the feet point and the toes are somewhat adducted and in line with the feet. The right arm and leg are less rigid in their posture than are the left arm and leg. The patient, as a rule, sleeps lying almost supine, his shoulders flat on the bed, with his head rotated to one side, the arms extended along the trunk, the right hip slightly elevated, and the legs flexed at hip and knee, the left leg lying under and just behind the right. When he stands up, with his body bent forwards, his arms hanging straight and stiff and a little in front of his trunk, his neck flexed and rigid, he is the picture of helplessness and immobility.

Tone: All the muscles of the trunk and four limbs are hypertonic except those of the ulnar fingers. Tonus preponderates in the extensor muscle groups, hence the prevailing posture of the trunk and limbs. Resistance to passive movement is greatest when the arms are being abducted or rotated at the shoulder, flexed at the elbow, the forearms supinated, the wrists extended, and the thumb abducted. The ulnar fingers are comparatively mobile. In the lower limbs the adductors of the thighs are more tonic than the abductors, and the extensors of the thighs, legs and feet than the flexors. Hypertonicity is greatest in the muscles controlling the large joints, and is least in the small muscles of the fingers. If the arm is passively flexed at the elbow with quick jerks the resistance encountered is quick and sudden, as if the triceps had taken up a new posture for each varying length. This "lengthening reaction" can be evoked over a wide range of different lengths of the muscle. It is obtained with all the muscles of the arm and thumb, but is most evident in the adductors of the shoulder, the extensors (triceps) of the elbow, the pronators of the forearm, the flexors of the wrist, and the adductors of the thumb. The extensors of the trunk and lower limbs show the reaction less clearly.

Involuntary movements: An emotional disturbance such as a fright may cause the arms to jerk forwards, but the most interesting involuntary movement in the arms is the following: It is a sudden and violent spasm in which there is adduction and internal rotation at the shoulder, extension at the elbow, extreme pronation of the forearm, slight flexion at the wrist, and hyperextension and adduction of the fingers, the index passing below the middle finger and the little finger below the ring finger. The thumb is adducted and opposed, the terminal phalanx remaining hyperextended. The hand and fingers form a cone and the palm looks backwards and outwards. It may be brought on by a fright or by a tickling feeling in the nose. Flexor and extensor spasms of the lower limbs still occur, but they are less frequent than formerly.

Reflexes: All the tendon reflexes are much increased. Flexion of the lower limb with upgoing toes is evoked by scratching the sole of the foot. With it the opposite lower limb extends. The extension-rotation reaction in the arm can be easily excited by scratching the palm of the hand, the inner aspect of the arm or the front of the chest, between the second and sixth ribs. The threshold of stimulus is lowest in the palm and on the chest between the third and fourth ribs. The complete response is as follows: The stimulated arm is suddenly and vigorously thrust backwards. It is extended, adducted and rotated

inwards at the shoulder, extended at the elbow, completely pronated, flexed at the wrist, the fingers being extended and in such a position that they form a cone with the middle finger in front and the thumb in the palm. The palm of the hand looks backwards and outwards. At the same time the trunk is rotated towards the stimulated arm, the opposite arm is adducted and rotated *outwards* at the shoulder, and slightly flexed at the elbow, while both lower limbs are extended, the ipsilateral more than the contralateral limb. The new posture is maintained for some seconds, though the exciting stimulus is brief, and then the body and limbs slowly assume their position of rest.

Sensation: All aspects of sensation are affected in the arms, trunk and lower limbs. Recognition of changes in posture, and of size, shape and form are grossly defective, especially in the hands and feet.

Bladder and rectum: He has almost complete control over the functions of the bladder. He still requires to take laxatives every day.

An Unusual Case of Complete Bilateral Spastic Paralysis of Face, Jaw, Tongue and Larynx, following an Acute Illness.

By JAMES COLLIER, M.D.

W. B., A GIRL, aged 10, was in every way healthy and normal until 6 years of age, when she is said to have contracted scarlet fever. Three weeks later, when convalescent from the scarlet fever, she is said to have acquired meningitis, the symptoms of which consisted in her developing a squint and becoming unconscious, and lying semiconscious for three weeks. Her limbs were not paralysed during this time. She has never been able to speak nor to move her face voluntarily, nor to eat nor swallow naturally since regaining consciousness. She is a very intelligent child and she writes well. With the exception that there is slight perversity of movement in the use of the fingers (she constantly uses the middle finger of both hands instead of the index finger for acts involving approximation with the thumb), the condition of the limbs and trunk are in every way normal. The ocular movements are normal, and are performed at command. With the exception of retraction of the angles of the mouth, there is no volitional movement of the face, jaw, tongue or larynx. The face is in spasm, as shown by the frowning expression and the retraction of the angles of the mouth.

The teeth are tightly clenched, with occasionally a little audible grinding, and the masseters are in spasm. There is much dribbling of saliva, which she circumvents with her handkerchief, so as to keep herself quite clean. She feeds by pressing soft food into her cheek with her finger, closing the oral aperture with the hand and squeezing it through the teeth by the pressure of her fingers upon the cheek. The reflex movement of the eyelids is normal. Reflex swallowing is normal. The emotional movements of the face in smiling and crying are normal, and during these movements only is the mouth opened, and it is then opened widely. The associated movements of the face on effort are normal. She makes no attempt at articulation. She has recently begun to use a slight laryngeal grunt as a query and as an affirmative.

INDEX

TO

BRAIN:

A JOURNAL OF NEUROLOGY

FOR

VOL. XLII, 1919.

INDEX OF AUTHORS.

PAGE

Brown, W. H., and Dujardin, B.
The cerobrospinal fluid in herpes zoster and the relation of herpes zoster to syphilis 86

Buzzard, E. Farquhar, and Greenfield, J. G.
Lethargic encephalitis; its sequelæ and morbid anatomy 305

Carver, Alfred, and Dinsley, A.
Some biological effects due to high explosives 113

Dinsley, A., and Carver, Alfred.
Some biological effects due to high explosives 113

Dujardin, B., and Brown, W. H.
The cerebrospinal fluid in herpes zoster and the relation of herpes zoster to syphilis 86

Greenfield, J. G., and Buzzard, E. Farquhar.
Lethargic encephalitis; its sequelæ and morbid anatomy 305

Greenfield, J. G.
The pathological examination of forty intracranial neoplasms 29

Jefferson, Geoffrey.
Gunshot wounds of the scalp, with special reference to the neurological signs presented 93

Jones, D. W. Carmalt.
War-neurasthenia, acute and chronic 171

Kooy, F. H.
Hyperglycæmia in mental disorders 214

Langelaan, J. W.
On the development of the external form of the human cerebellum 130

Prideaux, E.
Suggestion and suggestibility 291

Walshe, F. M. R.
Local paralysis following superficial injuries not involving nerve trunks, with special reference to traumatic "ascending neuritis" and to "reflex paralysis" .. 339

Walshe, F. M. R.
On the genesis and physiological significance of spasticity and other disorders of motor innervation, with a consideration of the functional relationships of the pyramidal system 1

INDEX OF SUBJECTS.

PAGE

Cerebellum, on the development of the external form of the human. J. W. Langelaan 130

Cerebrospinal fluid, the, in herpes zoster. W. H. Brown and B. Dujardin 86

Development of the external form of the human cerebellum. J. W. Langelaan .. 130

Encephalitis lethargica: its sequelæ and morbid anatomy. E. Farquhar Buzzard and J. G. Greenfield 305

Gunshot wounds of the scalp, with special reference to the neurological signs presented. Geoffrey Jefferson 93

Herpes zoster, relation of, to syphilis. W. H. Brown and B. Dujardin 86

Herpes zoster, the cerebrospinal fluid in. W. H Brown and B. Dujardin 86

High explosives, some biological effects due to. Alfred Carver and A. Dinsley .. 113

Hyperglycæmia in mental disorders. F. H. Kooy 214

Lethargic encephalitis: its sequelæ and morbid anatomy. E. Farquhar Buzzard and J. G. Greenfield 305

Mental disorders, hyperglycæmia in. F. H. Kooy 214

Neoplasms, the pathological examination of forty. J. G. Greenfield 29

Neurasthenia, war, acute and chronic. D. W. Carmalt Jones 171

Neuritis, ascending, local paralysis following superficial nerve injuries not involving nerve trunks, with special reference to "ascending neuritis" and "reflex paralysis." F. M. R. Walshe 339

Paralysis, local, following nerve injuries not involving nerve trunks, &c. F. M. R. Walshe 339

Pyramidal system, functional relationship of the, &c. F. M. R. Walshe 1

Reflex paralysis, local paralysis following peripheral injuries not involving nerve trunks, with special reference to "ascending neuritis," and to. F. M. R. Walshe 339

Spasticity and other disorders of motor innervation, physiological significance of, &c. F. M. R. Walshe 1

Suggestion and suggestibility. E. Prideaux 291

Syphilis, relation of herpes zoster to. W. H. Brown and B. Dujardin 86

War-neurasthenia, acute and chronic. D. W. Carmalt Jones 171